

Cyclotron

NSD 88-Inch Cyclotron

Procedure

Title: Safety Interlock System Chain Check Procedure			
Procedure Number: 88-PRO-001	Revision: REV. 2.0	Revision Date: 1 June 2006	Page 1 of 3
<hr/>		<hr/>	
Updated by Name Jim Morel Title Operations Supervisor	Date	Approved by Name Gudrun Kleist Title Electrical Group Coordinator	Date
<hr/>		<hr/>	
Approved by Name Dennis Collins Title Safety Committee Chairman	Date	Approved by Name Claude Lyneis Title Program Head	Date

1.0 PURPOSE

This procedure is a complete functional check of the Radiation Safety Interlock Chain System used for the protection of people at the LBL 88-Inch Cyclotron.

This procedure is to be performed yearly to comply with the required periodic Safety Interlock Chain check.

The bulk of this procedure is contained in the specific chain check checklists, located in the attachments, to be used to check the interlock chain for each area covered by the personnel radiation safety interlock system.

The Radiation Interlock Safety Chain System is one of several layers of protection intended to protect people from radiation hazards at the LBL 88-Inch Cyclotron. The "FAIL-SAFE" design feature of the Radiation Interlock Safety Chain System means that the failure of any one interlock system component will usually disable the Cyclotron beam, and will not compromise personnel safety. In most cases the chain check interlock function test is to verify the associated interlock function switch is in a safe state. The system

also protects against loss of control power and broken wires.

The procedure first disables the Cyclotron. Next the Radiation Interlock Safety Chain System chains are completed, and then each interlock function is tested to verify that the function will cause the chain to drop out. The tester will perform the actions in the areas being tested and the operator (in the control room) will report to the tester the results of the actions on the Radiation Interlock Safety Chain System. Additional personnel will participate as needed to facilitate the chain checks. The operator must confirm that the change to the Radiation Interlock Safety Chain System has occurred. The persons doing the chain checks must remain focused on the chain checks and their attention be dedicated to the chain check procedure.

Current copies of the following Schematics Diagrams are necessary to understand the function of each of the tests:

Safety Chain Schematic Diagram,
LBL 8W6365 1/2 T
Safety Chain Schematic Diagram,
LBL 8W6365 2/2 E

12 kV Vacuum Circuit Breaker Wiring Diagram,
LBL 12W6805
Pit Inspection Reset Schematic Diagram,
LBL 8W6984 C
Cave Hatch and Trench Schematic Diagram,
LBL 22W3214
Cave Hatch and Trench Schematic Diagram,
LBL 22W3214
Vault Door Control Schematic Diagram,
LBL 8W6355 J
Redundant Chain,
LBL 22W 4834

2.0 QUALIFICATION

This procedure is to be performed by qualified electrical group workers and assisted by control room operators. Only people already trained in this procedure may perform the chain checks.

This procedure may be performed by the persons who have completed NSD1001 "Safety Interlock System Chain Check Procedure" training. The EH&S Training Reports database may be checked to find the names of the persons that have completed the required training for this procedure.

3.0 HAZARD REVIEW

The performance of this procedure should not subject personnel to increased hazards above those associated with entering a controlled area. Upon entering controlled areas personnel must follow the established facility safety practices.

The performance of this procedure may subject personnel to the following potential hazards:

Radiation:

Hazard: Whenever personnel enter an experimental area where beam has been delivered components may emit x rays, beta rays, and gamma rays as a result of becoming activated during the run.

Mitigation: Review the area's survey form and plan the performance of the chain checks to minimize exposure. Care should be taken so that any dose received is As-Low-As-Reasonably-

Achievable (ALARA). The LBL ALARA (As-Low-As Reasonably-Achievable) Policy for personal radiation exposure applies to all work in a controlled area. When the potential to enter a radiation fields is encountered, the decision to continue, or not, is based upon the potential dose to be received by the personnel entering the area. Personnel must determine if there is a commensurate benefit from any exposure to be received.

4.0 PROCEDURE

4.1 CHAIN CHECK PREPARATION

The chain check procedure begins by first:

- 1) Disable the Cyclotron (Lock-out and Tag-out Circuit Breaker GE-50).
- 2) Make up the Radiation Interlock Safety Chain System for the area being tested.

4.2 CHAIN CHECKS

The chain check checklists list the specific steps and the correct order that they are to be performed. Follow the steps in the chain check checklist as indicated in the attachments list below:

<u>Area</u>	<u>Attachment</u>
Vault	A
Pit	B
Trench	C
Cave 0	D
Cave 1	E
Cave 2	F
Cave 3	G
Cave 4	H
Cave 4A	K
Cave 4B	M
Cave 4C	N
Beam Plugs	P

5.0 RECORDS

Records generated by compliance with this procedure are to be in compliance with RPM, Section 1.18, Records Management. Records generated through implementation of this procedure consist of the completed chain check checklists as filled out by the tester during the performance of the chain check. The

completed chain checks are stored in the EM shop and maintained by the electronic maintenance group. The performance of the chain checks is recorded in the Cyclotron Operations Logbook that is kept in the control room.

6.0 REVIEW OF PROCEDURE

Under the guidelines for DOE Order 420.2B, this procedure will be reviewed at least once every three years, or sooner if changes occur that may impact the appropriateness or implementation of this procedure.

REVISION HISTORY

13 February 1995: Updated and revised as V1.1.

2 February 1999: Updated as V1.2 to Excel checklist format.

1 June 2006: Updated and approved as V 2.0 to reflect current operating practices and implementation.

7.0 GLOSSARY

SEARCH AND SECURE (SAS) CHAIN: Some areas are equipped with Search and Secure chains which are push button stations located throughout an area. These buttons must be pushed by a SAS performer to indicate all parts of the area have been searched, all personnel were cleared, and the area was secured from entry and is safe for beam.

TESTER: The person conducting the chain checks who goes to each area being checked and performs the required tasks that check the function of the Radiation Safety Interlock Chain System components.

8.0 REFERENCES

1. Safety Chain Schematic Diagram,
LBL 8W6365 1/2 T
2. Safety Chain Schematic Diagram,
LBL 8W6365 2/2 E
3. 12 kV Vacuum Circuit Breaker Wiring Diagram,
LBL 12W6805
4. Pit Inspection Reset Schematic Diagram,
LBL 8W6984 C
5. Cave Hatch and Trench Schematic Diagram,
LBL 22W3214
6. Cave Hatch and Trench Schematic Diagram,

LBL 22W3214

7. Vault Door Control Schematic Diagram,
LBL 8W6355 J

8. Redundant Chain,
LBL 22W 4834

9. DOE Order: DOE O 420.2B, *Safety of Accelerator Facilities*

9.0 ATTACHMENTS

Revisions of the checklists for minor changes do not warrant a revision of the procedure. Substantial changes to the sequence of steps in the chain check checklist constitute a change significant enough to warrant a revision of the procedure.

Attachment A Chain Check for Vault
Attachment B Chain Check for Pit
Attachment C Chain Check for Trench
Attachment D Chain Check for Cave 0
Attachment E Chain Check for Cave 1
Attachment F Chain Check for Cave 2
Attachment G Chain Check for Cave 3
Attachment H Chain Check for Cave 4
Attachment K Chain Check for Cave 4A
Attachment M Chain Check for Cave 4B
Attachment N Chain Check for Cave 4C
Attachment P Chain Check for Beam Plugs

Attachment A: Vault Chain Check

PREPARATION FOR VAULT CHAIN CHECK

Current copies of the following drawings are necessary to appreciate the function of each test:

Safety Chain Schematic Diagram, LBL 8W 6365 1/2 T
Safety Chain Schematic Diagram, LBL 8W 6365 2/2 E
12 kV Vacuum Circuit Breaker Wiring Diagram, LBL 12W 6805
Pit Inspection Reset Schematic Diagram, LBL 8W 6984 C
Cave Hatch and Trench Schematic Diagram, LBL 22W 3214 D
Vault Inspection Chain Schematic Diagram, LBL 8W 6235 D
Vault Door Control Schematic Diagram, LBL 8W 6355 J
Redundant Chain, LBL 22W 4834

DISABLING THE CYCLOTRON

- [] Lock-out and Tag-out Circuit Breaker GE-50.
(GE-50 Kirk Key locked up with LoTo lock)

Completed by: _____ Date: _____

MAKE UP MAIN SAFETY CHAIN

- [] Search and Secure Vault, Pit and Trench.
(All beam plugs are closed)
(Check that Probe Door and Deflector Shield Block are in place)
(Main Safety Chain COMPLETE, A2111 - Lt 30 through A2116 - Lt 1)
(Cyclotron Redundant Radiation Safety Chain COMPLETE
to RF Permissive light @ A1711)

- [] Verify Main Safety Chain (Vault, Pit and Trench) is made up.

Completed by: _____ Date: _____

Attachment A: Vault Chain Check

VAULT CHAIN CHECK (8W 6365 1/2 T, 8W 6235 D, 8W 6355 J,

Requires 3 people, 3 radios

1 person in Vault, 1 radio
1 person outside Vault, 1 radio
1 person in Control Room, 1 radio

- [] Confirm Main Safety Chain **COMPLETE** @ A2116 - Lt 1.
- [] Confirm Cyclotron Redundant Radiation Safety Chain **COMPLETE** to RF Permissive light @ A1711.

- [] Verify Main Safety Chain **DROPS** @ A2111 - Lt 44 (Vault transfer keys in @ A938), when Vault Castell Key is removed from Sw - 1 in Control Room @ A938.
- [] Verify Cyclotron Redundant Radiation Safety Chain **DROPS** at Vault light @ A1711.

- [] Return Vault Castell Key to A938 Panel.

- [] Verify Main Safety Chain **COMPLETE** @ A2116 - Lt 1.
- [] Verify Cyclotron Redundant Radiation Safety Chain **COMPLETE** to RF Permissive light @ A1711.

- [] Verify Main Safety Chain **DROPS** @ A2111 - Lt 44 (Vault transfer keys in @ A938), when Vault Castell Key is removed from Sw - 2 in Control Room @ A938.
- [] Verify Cyclotron Redundant Radiation Safety Chain **DROPS** at Vault light @ A1711.

- [] Return Vault Castell Key to A938 Panel.

- [] Verify Main Safety Chain **COMPLETE** @ A2116 - Lt 1.
- [] Verify Cyclotron Redundant Radiation Safety Chain **COMPLETE** to RF Permissive light @ A1711.

- [] Verify Main Safety Chain **DROPS** @ A2111 - Lt 37 (Vault Run/Safe Sw #1, DE 200) when DE 200 is moved to SAFE position.
- [] Verify Cyclotron Redundant Radiation Safety Chain **DROPS** at Vault light @ A1711.

Attachment A: Vault Chain Check

- [] Return DE 200 to RUN position.

- [] Verify Main Safety Chain **COMPLETE** @ A2116 - Lt 1.
- [] Verify Cyclotron Redundant Radiation Safety Chain **COMPLETE** to RF Permissive light @ A1711.

- [] Verify Main Safety Chain **DROPS** @ A2111 - Lt 36 (Vault Run/Safe Sw #2, DE 210) when DE 210 is moved to SAFE position.
- [] Verify Cyclotron Redundant Radiation Safety Chain **DROPS** at Vault light @ A1711.

- [] Return DE 210 to RUN position.

- [] Verify Main Safety Chain **COMPLETE** @ A2116 - Lt 1.
- [] Verify Cyclotron Redundant Radiation Safety Chain **COMPLETE** to RF Permissive light @ A1711.

- [] Verify Main Safety Chain **DROPS** @ A2111 - Lt 35 (Vault Run/Safe Sw #3, DE 220) when DE 220 is moved to SAFE position.
- [] Verify Cyclotron Redundant Radiation Safety Chain **DROPS** at Vault light @ A1711.

- [] Return DE 220 to RUN position.

- [] Verify Main Safety Chain **COMPLETE** @ A2116 - Lt 1.
- [] Verify Cyclotron Redundant Radiation Safety Chain **COMPLETE** to RF Permissive light @ A1711.

- [] Verify Main Safety Chain **DROPS** @ A2111 - Lt 34 (Vault Run/Safe Sw #4, DE 230) when DE 230 is moved to SAFE position.
- [] Verify Cyclotron Redundant Radiation Safety Chain **DROPS** at Vault light @ A1711.

- [] Return DE 230 to RUN position.

- [] Verify Main Safety Chain **COMPLETE** @ A2116 - Lt 1.
- [] Verify Cyclotron Redundant Radiation Safety Chain **COMPLETE** to RF Permissive light @ A1711.

- [] Verify Main Safety Chain **DROPS** @ A2111 - Lt 33 (Vault Run/Safe Sw #5, DE 240) when DE 240 is moved to SAFE position.

Attachment A: Vault Chain Check

- [] Verify Cyclotron Redundant Radiation Safety Chain **DROPS** at Vault light @ A1711.
- [] Return DE 240 to RUN position.

- [] Verify Main Safety Chain **COMPLETE** @ A2116 - Lt 1.
- [] Verify Cyclotron Redundant Radiation Safety Chain **COMPLETE** to RF Permissive light @ A1711.

- [] Verify Main Safety Chain **DROPS** @ A2111 - Lt 32 (South Vault Gates Inner & Outer) when South Vault **inner** gate is OPENED.
- [] Verify Cyclotron Redundant Radiation Safety Chain **DROPS** at Vault light @ A1711.

- [] Close inner gate and press Vault Inspection Reset switch at South Vault Door.

- [] Verify Main Safety Chain **COMPLETE** @ A2116 - Lt 1.
- [] Verify Cyclotron Redundant Radiation Safety Chain **COMPLETE** to RF Permissive light @ A1711.

- [] Verify Main Safety Chain **DROPS** @ A2111 - Lt 49, when Run/Safe switch at South Vault Door Control Panel (R222) is moved to SAFE position.
- [] Verify Cyclotron Redundant Radiation Safety Chain **DROPS** at Vault light @ A1711.
- [] Return Run/Safe switch at R222 to RUN position.

- [] Verify Main Safety Chain **COMPLETE** @ A2116 - Lt 1.
- [] Verify Cyclotron Redundant Radiation Safety Chain **COMPLETE** to RF Permissive light @ A1711.

- [] Verify Main Safety Chain **DROPS** @ A2111 - Lt 48 (West Vault Gates Inner & Outer) when West Vault **inner** gate is OPENED.
- [] Verify Cyclotron Redundant Radiation Safety Chain **DROPS** at Vault light @ A1711.

- [] Close inner gate and press Vault Inspection Reset switch at West Vault Door.

- [] Verify Main Safety Chain **COMPLETE** @ A2116 - Lt 1.
- [] Verify Cyclotron Redundant Radiation Safety Chain **COMPLETE** to RF Permissive light @ A1711.

Attachment A: Vault Chain Check

- [] Verify Main Safety Chain **DROPS** @ A2111 - Lt 45, when Run/Safe switch at West Vault Door Control Panel (R122) is moved to SAFE position.
- [] Verify Cyclotron Redundant Radiation Safety Chain **DROPS** at Vault light @ A1711.
- [] Return Run/Safe switch at R122 to RUN position.
- [] Verify Main Safety Chain **COMPLETE** @ A2116 - Lt 1.
- [] Verify Cyclotron Redundant Radiation Safety Chain **COMPLETE** to RF Permissive light @ A1711.
- [] Verify door hydraulic pump is switched OFF.
- [] Verify Main Safety Chain **DROPS** @ A2111 - Lt 46 (West Vault Door Closed), when West Vault Door Emergency Exit PB is PRESSED. (West Vault concrete door should OPEN)
- [] Verify Cyclotron Redundant Radiation Safety Chain **DROPS** at Vault light @ A1711.
- [] Verify none of 3 Castell Keys at West Vault Door Control Panel can be turned or removed without Control Room Vault Castell Key inserted and turned 45 degrees to the right.
- [] Verify Main Safety Chain **DROPS** @ A2111 - Lt 47 (West Vault Keys in, transfer key removed @ R128), when Control Room Vault Castell Key is INSERTED AND TURNED at West Vault Door Control Panel.
- [] Verify Cyclotron Redundant Radiation Safety Chain remains **DROPPED** at Vault light @ A1711.
- [] Remove Control Room Vault Castell Key from West Vault Panel R128.
- [] Close West Vault Door. Go to South Vault Door Control Panel.
- [] Verify door hydraulic pump is switched OFF.
- [] Verify Main Safety Chain **DROPS** @ A2111 - Lt 50 (South Vault Door Closed), when South Vault Door Emergency Exit PB is PRESSED. (South Vault concrete door should OPEN)
- [] Verify Cyclotron Redundant Radiation Safety Chain remains **DROPPED** at Vault light @ A1711.
- [] Verify none of 3 Castell Keys at South Vault Door Control Panel can be

Attachment A: Vault Chain Check

turned or removed without Control Room Vault Castell Key inserted in this panel and turned 45 degrees to the right.

- [] Take Control Room Vault Castell Key to the South Vault Door Control Panel @ R228.

- [] Verify Main Safety Chain **DROPS** @ A2111 - Lt 31 (South Vault Keys in, transfer key removed @ R228), when Control Room Vault Castell Key is INSERTED AND TURNED at South Vault Door Control Panel.
- [] Verify Cyclotron Redundant Radiation Safety Chain remains **DROPPED** at Vault light @ A1711.

- [] Remove Control Room Vault Transfer Key from South Vault Panel R228.
- [] Close South Vault Door.
- [] Return Control Room Vault Castell Key to A938 Panel in Control Room.

- [] Verify Main Safety Chain **COMPLETE** @ A2116 - Lt 1.
- [] Verify Cyclotron Redundant Radiation Safety Chain **COMPLETE** to RF Permissive light @ A1711.

Completed by: _____ Date: _____

Attachment B: Pit Chain Check

PREPARATION FOR PIT CHAIN CHECK

Current copies of the following drawings are necessary to appreciate the function of each test:

Safety Chain Schematic Diagram, LBL 8W 6365 1/2 T
Safety Chain Schematic Diagram, LBL 8W 6365 2/2 E
12 kV Vacuum Circuit Breaker Wiring Diagram, LBL 12W 6805
Pit Inspection Reset Schematic Diagram, LBL 8W 6984 C
Cave Hatch and Trench Schematic Diagram, LBL 22W 3214 D
Vault Inspection Chain Schematic Diagram, LBL 8W 6235 D
Vault Door Control Schematic Diagram, LBL 8W 6355 J
Redundant Chain, LBL 22W 4834

DISABLING THE CYCLOTRON

- [] Lock-out and Tag-out Circuit Breaker GE-50.
(GE-50 Kirk Key locked up with LoTo lock)

Completed by: _____ Date: _____

MAKE UP MAIN SAFETY CHAIN

- [] Search and Secure Vault, Pit and Trench.
(All beam plugs are closed)
(Check that Probe Door and Deflector Shield Block are in place)
(Main Safety Chain COMPLETE, A2111 - Lt 30 through A2116 - Lt 1)
(Cyclotron Redundant Radiation Safety Chain COMPLETE
to RF Permissive light @ A1711)

- [] Verify Main Safety Chain (Vault, Pit and Trench) is made up.

Completed by: _____ Date: _____

Attachment B: Pit Chain Check

PIT CHAIN CHECK (8W 6365 1/2 T, 8W 6984 C, 22W 4834)

Requires 4 people, 3 radios

2 people in Pit, 1 radio
1 person at West Outer Pit Gate, 1 radio
1 person in Control Room, 1 radio

Pit Safety Switch - 1

(on print, Pit Run/Safe Sw 1 BE 140)

- [] Confirm Main Safety Chain COMPLETE @ A2116 - Lt 1.
- [] Confirm Cyclotron Redundant Radiation Safety Chain COMPLETE to RF Permissive light @ A1711.

- [] Verify Main Safety Chain drops @ PIT RUN/SAFE SW 1, A2111 - Lt 29, when BE 140 is moved to SAFE position.
- [] Verify Cyclotron Redundant Radiation Safety Chain drops to Pit light @ A1711.

- [] Verify Main Safety Chain COMPLETE @ A2116 - Lt 1, when BE 140 is returned to RUN position.
- [] Verify Cyclotron Redundant Radiation Safety Chain COMPLETE to RF Permissive light @ A1711.

Pit Safety Switch - 2

(on print, Pit Run/Safe Sw 2 BE 150)

- [] Confirm Main Safety Chain COMPLETE @ A2116 - Lt 1.
- [] Confirm Cyclotron Redundant Radiation Safety Chain COMPLETE to RF Permissive light @ A1711.

- [] Verify Main Safety Chain drops @ PIT RUN/SAFE SW 2, A2111 - Lt 28, when BE 150 is moved to SAFE position.
- [] Verify Cyclotron Redundant Radiation Safety Chain drops to Pit light @ A1711.

Attachment B: Pit Chain Check

- [] Verify Main Safety Chain COMPLETE @ A2116 - Lt 1, when BE 150 is returned to RUN position.
- [] Verify Cyclotron Redundant Radiation Safety Chain COMPLETE to RF Permissive light @ A1711.

West Pit Door Safety Switch (Outer)

(on print, West Pit Tunnel Run/Safe Sw B211)

- [] Confirm Main Safety Chain COMPLETE @ A2116 - Lt 1.
- [] Confirm Cyclotron Redundant Radiation Safety Chain COMPLETE to RF Permissive light @ A1711.
- [] Verify Main Safety Chain drops @ WEST PIT SAFETY SWITCH, A2111 - Lt 25, when B 211 is moved to SAFE position.
- [] Verify Cyclotron Redundant Radiation Safety Chain drops to Pit light @ A1711.
- [] Verify Main Safety Chain COMPLETE @ A2116 - Lt 1, when B 211 is returned to RUN position.
- [] Verify Cyclotron Redundant Radiation Safety Chain COMPLETE to RF Permissive light @ A1711.

East Pit Door

- [] Confirm Main Safety Chain COMPLETE @ A2116 - Lt 1.
- [] Confirm Cyclotron Redundant Radiation Safety Chain COMPLETE to RF Permissive light @ A1711.
- [] Verify Main Safety Chain drops @ EAST PIT DOOR, A2111 - Lt 27, when opening east pit door to pump room.
- [] Verify Cyclotron Redundant Radiation Safety Chain drops to Pit light @ A1711.
- [] Close East Pit Door. Verify Main Chain made up through A2111 - Lt 22.
- [] Reset 2 Pit search station PB switches and PB switch at West Outer Pit Door.
- [] Verify Main Safety Chain COMPLETE @ A2116 - Lt 1.

Attachment B: Pit Chain Check

- [] Verify Cyclotron Redundant Radiation Safety Chain COMPLETE to RF Permissive light @ A1711.

West Pit Doors (Inner and Outer)

- [] Confirm Main Safety Chain COMPLETE @ A2116 - Lt 1.
- [] Confirm Cyclotron Redundant Radiation Safety Chain COMPLETE to RF Permissive light @ A1711.

- [] Verify Main Safety Chain drops @ PIT INSPECTION RESET, A2111 - Lt 21 when **inner** west door is opened.
- [] Verify Cyclotron Redundant Radiation Safety Chain drops to Pit light @ A1711.

- [] Close West Pit Inner Door while remaining inside, and reset 2 Pit search station PB switches and PB switch at West Outer Pit Door. Lamps in PB switches should glow.

- [] Verify Main Safety Chain COMPLETE @ A2116 - Lt 1.
- [] Verify Cyclotron Redundant Radiation Safety Chain COMPLETE to RF Permissive light @ A1711.

- [] Press **inner** pit door BYPASS switch. Measure duration of bypass:_____sec. (Must be less than 20 sec.)
Press **inner** pit door BYPASS switch again and go out the door.

- [] Press **outer** pit door BYPASS switch. Measure duration of bypass:_____sec. (Must be less than 20 sec.)

- [] Verify Main Safety Chain drops @ PIT WEST OUTER DOOR, A2111 - Lt 26, when **outer** west door is opened.
- [] Verify Cyclotron Redundant Radiation Safety Chain drops to Pit light @ A1711.

- [] Close West Pit Outer Door while remaining inside.
- [] Verify Main Safety Chain is now broken @ PIT INSPECTION RESET, A2111 - Lt 21.
- [] Verify Cyclotron Redundant Radiation Safety Chain remains dropped to Pit light @ A1711.

- [] Search and Secure the Pit in the normal way.

- [] Verify Main Safety Chain COMPLETE @ A2116 - Lt 1.

Attachment B: Pit Chain Check

- [] Verify Cyclotron Redundant Radiation Safety Chain COMPLETE to RF Permissive light @ A1711.

Pit Key - 1

- [] Confirm Main Safety Chain COMPLETE @ A2116 - Lt 1.
- [] Confirm Cyclotron Redundant Radiation Safety Chain COMPLETE to RF Permissive light @ A1711.

- [] Remove Best **Pit Key - 1** from A941 in Control Room.

- [] Verify Main Safety Chain drops @ A2111 - Lt 40, when Best key is turned and removed.
- [] Verify Cyclotron Redundant Radiation Safety Chain drops to Pit light @ A1711.

- [] Insert **Pit Key - 1** at A941 and turn fully to the right.

- [] Verify Main Safety Chain COMPLETE @ A2116 - Lt 1.
- [] Verify Cyclotron Redundant Radiation Safety Chain COMPLETE to RF Permissive light @ A1711.

Pit Key - 2

- [] Confirm Main Safety Chain COMPLETE @ A2116 - Lt 1.
- [] Confirm Cyclotron Redundant Radiation Safety Chain COMPLETE to RF Permissive light @ A1711.

- [] Remove Best **Pit Key - 2** from A941 in Control Room.

- [] Verify Main Safety Chain drops @ A2111 - Lt 39, when Best key is turned and removed.
- [] Verify Cyclotron Redundant Radiation Safety Chain drops to Pit light @ A1711.

- [] Insert **Pit Key - 2** at A941 and turn fully to the right.

- [] Verify Main Safety Chain COMPLETE @ A2116 - Lt 1.
- [] Verify Cyclotron Redundant Radiation Safety Chain COMPLETE to RF Permissive light @ A1711.

Attachment B: Pit Chain Check

Pit East Entrance Gate

- [] Confirm Main Safety Chain COMPLETE @ A2116 - Lt 1.
- [] Confirm Cyclotron Redundant Radiation Safety Chain COMPLETE to RF Permissive light @ A1711.

- [] Verify Main Safety Chain drops @ EAST PIT GATE JE 10, A2111 - Lt 22, when east pit gate is opened.
- [] Verify Cyclotron Redundant Radiation Safety Chain drops to Pit light @ A1711.

- [] Close gate.

- [] Verify Main Safety Chain COMPLETE @ A2116 - Lt 1.
- [] Verify Cyclotron Redundant Radiation Safety Chain COMPLETE to RF Permissive light @ A1711.

Pit Chain Check

Completed by: _____ Date: _____

Attachment C: Trench Chain Check

PREPARATION FOR TRENCH CHAIN CHECK

Current copies of the following drawings are necessary to appreciate the function of each test:

Safety Chain Schematic Diagram, LBL 8W 6365 1/2 T
Safety Chain Schematic Diagram, LBL 8W 6365 2/2 E
12 kV Vacuum Circuit Breaker Wiring Diagram, LBL 12W 6805
Pit Inspection Reset Schematic Diagram, LBL 8W 6984 C
Cave Hatch and Trench Schematic Diagram, LBL 22W 3214 D
Vault Inspection Chain Schematic Diagram, LBL 8W 6235 D
Vault Door Control Schematic Diagram, LBL 8W 6355 J
Redundant Chain, LBL 22W 4834

DISABLING THE CYCLOTRON

- [] Lock-out and Tag-out Circuit Breaker GE-50.
(GE-50 Kirk Key locked up with LoTo lock)

Completed by: _____ Date: _____

MAKE UP MAIN SAFETY CHAIN

- [] Search and Secure Vault, Pit and Trench.
(All beam plugs are closed)
(Check that Probe Door and Deflector Shield Block are in place)
(Main Safety Chain COMPLETE, A2111 - Lt 30 through A2116 - Lt 1)
(Cyclotron Redundant Radiation Safety Chain COMPLETE
to RF Permissive light @ A1711)

- [] Verify Main Safety Chain (Vault, Pit and Trench) is made up.

Completed by: _____ Date: _____

Attachment C: Trench Chain Check

TRENCH CHAIN CHECK (8W 6365 1/2 T, 22W 3214 D, 22W 4834)

Requires 4 people, 3 radios

2 people in Trench, 1 radio
1 person outside Trench, 1 radio
1 person in Control Room, 1 radio

- [] Confirm Main Safety Chain COMPLETE @ A2116 - Lt 1.
- [] Confirm Cyclotron Redundant Radiation Safety Chain COMPLETE to RF Permissive light @ A1711.

- [] Open Trench Door.

- [] Verify that the Main Safety Chain drops @ A2111 - Lt 38.
- [] Verify Cyclotron Redundant Radiation Safety Chain drops at Trench light @ A1711.

- [] Verify lights go out at Trench Door Inspection Reset Box OUTSIDE Trench.

- [] Verify lights go out at Redundant Trench Door and Hatches Inspection Reset Box OUTSIDE Trench.

- [] Close Trench Door. Reset PB switches. Lamps in PB switches should glow.

- [] Verify Main Safety Chain COMPLETE @ A2116 - Lt 1.
- [] Verify Cyclotron Redundant Radiation Safety Chain COMPLETE to RF Permissive light @ A1711.

- [] Move RUN/SAFE Switch at Trench Door Inspection Reset Box OUTSIDE Trench to SAFE position.

- [] Verify that the Main Safety Chain drops @ A2111 - Lt 38.
- [] Verify Cyclotron Redundant Radiation Safety Chain drops at Trench light @ A1711.

- [] Verify lights go out at Trench Door Inspection Reset Box OUTSIDE Trench.

- [] Return RUN/SAFE Switch to RUN position. Reset PB switch. Lamp in PB switch should glow.

Attachment C: Trench Chain Check

- [] Verify Main Safety Chain COMPLETE@A2116 - Lt 1.
- [] Verify Cyclotron Redundant Radiation Safety Chain COMPLETE to RF Permissive light @ A1711.

- [] Move RUN/SAFE Switch at Hatches Inspection Reset Box INSIDE Trench to SAFE position.

- [] Verify that the Main Safety Chain drops @ A2111 - Lt 38.
- [] Verify Cyclotron Redundant Radiation Safety Chain drops at Trench light @ A1711.

- [] Verify lights go out at Hatches Inspection Reset Box INSIDE Trench.

- [] Return RUN/SAFE Switch to RUN position. Reset PB switch. Lamp in PB switch should glow.

- [] Verify Main Safety Chain COMPLETE@A2116 - Lt 1.
- [] Verify Cyclotron Redundant Radiation Safety Chain COMPLETE to RF Permissive light @ A1711.

- [] Move RUN/SAFE Switch at Redundant Trench Door and Hatches Inspection Reset Box OUTSIDE Trench to SAFE position.

- [] Main Safety Chain is not affected.
- [] Verify Cyclotron Redundant Radiation Safety Chain drops at Trench light @ A1711.

- [] Verify lights go out at Redundant Trench Door and Hatches Inspection Reset Box OUTSIDE Trench.

- [] Return RUN/SAFE Switch to RUN position. Reset PB switch. Lamp in PB switch should glow.

- [] OPEN Hatch to Cave 3.

- [] Verify that the Main Safety Chain drops @ A2111 - Lt 38.
- [] Verify Cyclotron Redundant Radiation Safety Chain drops at Trench light @ A1711.

- [] Verify lights go out at Hatches Inspection Reset Box INSIDE Trench.

- [] Verify lights go out at Redundant Trench Door and Hatches Inspection

Attachment C: Trench Chain Check

Reset Box OUTSIDE Trench.

- [] CLOSE Cave 3 Hatch. Reset PB switches. Lamps in PB switches should glow.
- [] Verify Main Safety Chain COMPLETE@A2116 - Lt 1.
- [] Verify Cyclotron Redundant Radiation Safety Chain COMPLETE to RF Permissive light @ A1711.
- [] OPEN Hatch to Cave 2.
- [] Verify that the Main Safety Chain drops @ A2111 - Lt 38.
- [] Verify Cyclotron Redundant Radiation Safety Chain drops at Trench light @ A1711.
- [] Verify lights go out at Hatches Inspection Reset Box INSIDE Trench.
- [] Verify lights go out at Redundant Trench Door and Hatches Inspection Reset Box OUTSIDE Trench.
- [] CLOSE Cave 2 Hatch. Reset PB switches. Lamps in PB switches should glow.
- [] Verify Main Safety Chain COMPLETE@A2116 - Lt 1.
- [] Verify Cyclotron Redundant Radiation Safety Chain COMPLETE to RF Permissive light @ A1711.
- [] OPEN Hatch to Cave 1.
- [] Verify that the Main Safety Chain drops @ A2111 - Lt 38.
- [] Verify Cyclotron Redundant Radiation Safety Chain drops at Trench light @ A1711.
- [] Verify lights go out at Hatches Inspection Reset Box INSIDE Trench.
- [] Verify lights go out at Redundant Trench Door and Hatches Inspection Reset Box OUTSIDE Trench.
- [] CLOSE Cave 1 Hatch. Reset PB switches. Lamps in PB switches should glow.
- [] Verify Main Safety Chain COMPLETE@A2116 - Lt 1.
- [] Verify Cyclotron Redundant Radiation Safety Chain COMPLETE

Attachment C: Trench Chain Check

to RF Permissive light @ A1711.

- [] Remove Best **Trench Key** from A941 in Control Room.
Verify that the Main Safety Chain drops @ A2111 - Lt 38, when Best key is turned and removed.
- [] Verify Cyclotron Redundant Radiation Safety Chain drops at Trench light @ A1711.

- [] Insert **Trench Key** at A941 and turn fully to the right.
Verify Main Safety Chain COMPLETE@A2116 - Lt 1.
- [] Verify Cyclotron Redundant Radiation Safety Chain COMPLETE to RF Permissive light @ A1711.

Trench Chain Check

Completed by: _____ Date: _____

Attachment D: Cave 0 Chain Check

PREPARATION FOR CAVE 0 CHAIN CHECK

Current copies of the following drawings are necessary to appreciate the function of each test:

Safety Chain Schematic Diagram, LBL 8W 6365 1/2 T
Beam Plug & Guillotine Control Schematic Diagram, LBL 8W 6975 P
HLC Door Control Panel Schematic Diagram, LBL 8W 7913 B
Redundant Chain, LBL 22W 4834

DISABLING THE CYCLOTRON

[] Lock-out and Tag-out Circuit Breaker GE-50.
(GE-50 Kirk Key locked up with LoTo lock)

Completed by: _____ Date: _____

CAVE 0 CHAIN CHECK

(8W 6365 1/2 T, 8W 6975 P, 8W 7913 B)

Requires 3 people, 3 radios

1 person inside Cave 0,
1 person outside Cave 0,
1 person in Control Room,

NOTE: This checklist assumes that the Main Safety Chain is **NOT** complete.

[] Check radiation survey of Cave 0.
(Stay away from hot areas, practice ALARA)

Attachment D: Cave 0 Chain Check

- [] Make up Cave 0 Safety Chain with one person in cave.
[Cave 0 Castell Key to A938 Panel in Control Room.]
- [] Verify Cave 0 Safety Chain **COMPLETE** @ A2116 - Lt 11.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF** and Cave 0 Safety Chain OK light **ON**,
Cave 0 Beam Plug In light **ON**)

- [] Verify Cave 0 Safety Chain **DROPS** @ A2116 - Lt 18,
(Cave 0 R/S Sw 1), when Run/Safe Switch at inspection reset box
ME 0 on upstream north cave wall, is moved to SAFE position.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF** and Cave 0 Safety Chain OK light **OFF**,
Cave 0 Beam Plug In light **ON**)

- [] Return Run/Safe Switch to RUN position.

- [] Verify Cave 0 Safety Chain **COMPLETE** @ A2116 - Lt 11.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF** and Cave 0 Safety Chain OK light **ON**,
Cave 0 Beam Plug In light **ON**)

- [] Verify Cave 0 Safety Chain **DROPS** @ A2116 - Lt 17,
(Cave 0 R/S Sw 2), when Run/Safe Switch at inspection reset box
ME 10 on downstream east cave wall, is moved to SAFE position.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF** and Cave 0 Safety Chain OK light **OFF**,
Cave 0 Beam Plug In light **ON**)

- [] Return Run/Safe Switch to RUN position.

- [] Verify Cave 0 Safety Chain **COMPLETE** @ A2116 - Lt 11.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF** and Cave 0 Safety Chain OK light **ON**,
Cave 0 Beam Plug In light **ON**)

- [] Verify Cave 0 Safety Chain **DROPS** @ A2116 - Lt 15,
(Cave 0 Door R/S Switch), when Run/Safe Switch at Cave 0 Door
Controls Panel M110, outside Cave 0 Door, is moved to SAFE position.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF** and Cave 0 Safety Chain OK light **OFF**,
Cave 0 Beam Plug In light **ON**)

- [] Return Run/Safe Switch to RUN position.

Attachment D: Cave 0 Chain Check

- [] Verify Cave 0 Safety Chain **COMPLETE** @ A2116 - Lt 11.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF** and Cave 0 Safety Chain OK light **ON**,
Cave 0 Beam Plug In light **ON**)

- [] Verify Cave 0 Safety Chain **DROPS** @ A2116 - Lt 14,
(Cave 0 Xfer Key in at Ctrl Room), when Cave 0 Castell Key
is removed from A938 Panel in Control Room.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF** and Cave 0 Safety Chain OK light **OFF**,
Cave 0 Beam Plug In light **ON**)

- [] Return Cave 0 Castell Key to fully engaged position in A938 Panel.

- [] Verify Cave 0 Safety Chain **COMPLETE** @ A2116 - Lt 11.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF** and Cave 0 Safety Chain OK light **ON**,
Cave 0 Beam Plug In light **ON**)

- [] Verify Cave 0 Safety Chain **DROPS** @ A2116 - Lt 16,
(Cave 0 Door Closed), when Emergency Door Open PB Switch
inside Cave 0 Door is pushed. [Cave 0 Door should OPEN.]
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF** and Cave 0 Safety Chain OK light **OFF**,
Cave 0 Beam Plug In light **ON**)

Completed by: _____ Date: _____

Attachment E: Cave 1 Chain Check

PREPARATION FOR CAVE 1 CHAIN CHECK

Current copies of the following drawings are necessary to appreciate the function of each test:

Safety Chain Schematic Diagram, LBL 8W 6365 1/2 T
Beam Plug & Guillotine Control Schematic Diagram, LBL 8W 6975 P
Redundant Chain, LBL 22W 4834

DISABLING THE CYCLOTRON

- [] Lock-out and Tag-out Circuit Breaker GE-50.
(GE-50 Kirk Key locked up with LoTo lock)

Completed by: _____ Date: _____

CAVE 1 CHAIN CHECK

(8W 6365 1/2 T, 8W 6975 P, 22W 4834)

Requires 3 people, 3 radios, 1 screwdriver

1 person inside Cave 1,
1 person outside Cave 1,
1 person in Control Room,

NOTE: This checklist assumes that the Main Safety Chain is **NOT** complete.

- [] Check radiation survey of Cave 1.
(Stay away from hot areas, practice ALARA)
- [] Make up Cave 1 with one person in cave.
Note that red fluorescent lights come on.

Attachment E: Cave 1 Chain Check

- [] Remove Castell Key from Cave 1 Door Controls Panel.
- [] Verify Cave 1 Safety Chain **made up through** A2116 - Lt 24.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF** and Cave 1 Safety Chain OK light **OFF**,
Cave 1 Beam Plug In light **ON**)
- [] Verify Cave 1 Safety Chain **DROPS** @ A2116 - Lt 26,
(Cave 1 Xfer Key Out @ N118), when Cave 1 Castell Key is inserted
and turned clockwise at Cave 1 Door Controls Panel N118.
- [] Cyclotron Redundant Radiation Safety Chain @ A1711 reads as above.
- [] Verify Cave 1 Safety Chain **DROPS** @ A2116 - Lt 27,
(Cave 1 Door Closed), when Cave 1 Door is OPENED from inside.
- [] Cyclotron Redundant Radiation Safety Chain @ A1711 reads as above.
- [] Make up Cave 1 Safety Chain with one person in the cave.
[Cave 1 Castell Key to A938 Panel in Control Room.]
- [] Verify Cave 1 Safety Chain **COMPLETE** @ A2116 - Lt 21.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF** and Cave 1 Safety Chain OK light **ON**,
Cave 1 Beam Plug In light **ON**)
- [] Verify Cave 1 Safety Chain **DROPS** @ A2116 - Lt 29,
(Cave 1 R/S Sw 1), when Run/Safe Switch at inspection reset box
NE 10 on upstream west cave wall, is moved to SAFE position.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF** and Cave 1 Safety Chain OK light **OFF**,
Cave 1 Beam Plug In light **ON**)
- [] Return Run/Safe Switch to RUN position.
- [] Verify Cave 1 Safety Chain **COMPLETE** @ A2116 - Lt 21.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF** and Cave 1 Safety Chain OK light **ON**,
Cave 1 Beam Plug In light **ON**)
- [] Verify Cave 1 Safety Chain **DROPS** @ A2116 - Lt 28,
(Cave 1 R/S Sw 2), when Run/Safe Switch at inspection reset box
NE 20 on downstream west cave wall, is moved to SAFE position.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF** and Cave 1 Safety Chain OK light **OFF**,

Attachment E: Cave 1 Chain Check

Cave 1 Beam Plug In light **ON**)

- [] Return Run/Safe Switch to RUN position.
- [] Verify Cave 1 Safety Chain **COMPLETE** @ A2116 - Lt 21.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF** and Cave 1 Safety Chain OK light **ON**,
Cave 1 Beam Plug In light **ON**)

- [] Verify Cave 1 Safety Chain **DROPS** @ A2116 - Lt 25,
(Cave 1 Door R/S Switch), when Run/Safe Switch at inspection reset
panel N110 outside Cave 1 Door, is moved to SAFE position.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF** and Cave 1 Safety Chain OK light **OFF**,
Cave 1 Beam Plug In light **ON**)

- [] Return Run/Safe Switch to RUN position.

- [] Verify Cave 1 Safety Chain **COMPLETE** @ A2116 - Lt 21.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF** and Cave 1 Safety Chain OK light **ON**,
Cave 1 Beam Plug In light **ON**)

- [] Verify Cave 1 Safety Chain **DROPS** @ A2116 - Lt 23,
(Cave 1 Xfer Key In @ A938), when Cave 1 Castell Key
is removed from A938 Panel in Control Room.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF** and Cave 1 Safety Chain OK light **OFF**,
Cave 1 Beam Plug In light **ON**)

- [] Return Cave 1 Castell Key to fully engaged position in A938 Panel.

- [] Verify Cave 1 Safety Chain **COMPLETE** @ A2116 - Lt 21.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF** and Cave 1 Safety Chain OK light **ON**,
Cave 1 Beam Plug In light **ON**)

- [] Verify Cave 1 Safety Chain **DROPS** @ A2116 - Lt 24,
(Cave 1 Electric Lock Intlk), when internal **[interlock test]** PB switch
inside inspection reset box N118 at Cave 1 Door is pushed.
[Screwdriver needed to access reset box.]
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF** and Cave 1 Safety Chain OK light **ON**,
Cave 1 Beam Plug In light **ON**)

Attachment E: Cave 1 Chain Check

Completed by: _____ Date: _____

Attachment F: Cave 2 Chain Check

PREPARATION FOR CAVE 2 CHAIN CHECK

Current copies of the following drawings are necessary to appreciate the function of each test:

Safety Chain Schematic Diagram, LBL 8W 6365 1/2 T
Beam Plug & Guillotine Control Schematic Diagram, LBL 8W 6975 P
Cave 2 and Cave 3 Door Controls Schematic Diagram, LBL 8W 8075 D
Redundant Chain, LBL 22W 4834

DISABLING THE CYCLOTRON

- [] Lock-out and Tag-out Circuit Breaker GE-50.
(GE-50 Kirk Key locked up with LoTo lock)

Completed by: _____ Date: _____

CAVE 2 CHAIN CHECK

(8W 6365 1/2 T, 8W 6975 P, 8W 8075 D, 22W 4834)

Requires 3 people, 3 radios

1 person inside Cave 2,
1 person outside Cave 2,
1 person in Control Room,

NOTE: This checklist assumes that the Main Safety Chain is **NOT** complete.

- [] Check radiation survey of Cave 2.
(Stay away from hot areas, practice ALARA)
- [] Make up Cave 2 with one person in cave.

Attachment F: Cave 2 Chain Check

- [] Remove Castell Key from Cave 2 Door Controls Panel.

- [] Verify Cave 2 Safety Chain **made up through** A2116 - Lt 33.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF** and Cave 2 Safety Chain OK light **OFF**,
Cave 2 Beam Plug In light **ON**)

- [] Verify Cave 2 Safety Chain **DROPS** @ A2116 - Lt 36,
(Cave 2 Door Key), when Cave 2 Castell Key is inserted
and turned clockwise at Cave 2 Door Controls Panel P110.
- [] Cyclotron Redundant Radiation Safety Chain @ A1711 reads as above.

- [] Make up Cave 2 Safety Chain with one person in cave.
[Cave 2 Castell Key to A938 panel in Control Room]

- [] Verify Cave 2 Safety Chain **COMPLETE** @ A2116 - Lt 31.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF** and Cave 2 Safety Chain OK light **ON**,
Cave 2 Beam Plug In light **ON**)

- [] Verify Cave 2 Safety Chain **DROPS** @ A2116 - Lt 38,
(Cave 2 R/S Sw 1), when Run/Safe Switch at inspection reset box
PE 10 on upstream west cave wall, is moved to SAFE position.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF** and Cave 2 Safety Chain OK light **OFF**,
Cave 2 Beam Plug In light **ON**)

- [] Return Run/Safe Switch to RUN position.

- [] Verify Cave 2 Safety Chain **COMPLETE** @ A2116 - Lt 31.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF** and Cave 2 Safety Chain OK light **ON**,
Cave 2 Beam Plug In light **ON**)

- [] Verify Cave 2 Safety Chain **DROPS** @ A2116 - Lt 37,
(Cave 2 R/S Sw 2), when Run/Safe Switch at inspection reset box
PE 20 on downstream west cave wall, is moved to SAFE position.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF** and Cave 2 Safety Chain OK light **OFF**,
Cave 2 Beam Plug In light **ON**)

- [] Return Run/Safe Switch to RUN position.

Attachment F: Cave 2 Chain Check

- [] Verify Cave 2 Safety Chain **COMPLETE** @ A2116 - Lt 31.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF** and Cave 2 Safety Chain OK light **ON**,
Cave 2 Beam Plug In light **ON**)

- [] Verify Cave 2 Safety Chain **DROPS** @ A2116 - Lt 33,
(Cave 2 Door R/S Switch), when Run/Safe Switch at inspection reset
panel P110 outside Cave 2 Door, is moved to SAFE position.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF** and Cave 2 Safety Chain OK light **OFF**,
Cave 2 Beam Plug In light **ON**)

- [] Return Run/Safe Switch to RUN position.

- [] Verify Cave 2 Safety Chain **COMPLETE** @ A2116 - Lt 31.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF** and Cave 2 Safety Chain OK light **ON**,
Cave 2 Beam Plug In light **ON**)

- [] Verify Cave 2 Safety Chain **DROPS** @ A2116 - Lt 32,
(Cave 2 Xfer Key In @ A938), when Cave 2 Castell Key
is removed from A938 Panel in Control Room.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF** and Cave 2 Safety Chain OK light **OFF**,
Cave 2 Beam Plug In light **ON**)

- [] Return Cave 2 Castell Key to fully engaged position in A938 Panel.

- [] Verify Cave 2 Safety Chain **COMPLETE** @ A2116 - Lt 31.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF** and Cave 2 Safety Chain OK light **ON**,
Cave 2 Beam Plug In light **ON**)

- [] Verify Cave 2 Safety Chain **DROPS** @ A2116 - Lt 34,
(Cave 2 Inner/Outer Gates), when Cave 2 Inner Gate is OPENED.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF** and Cave 2 Safety Chain OK light **OFF**,
Cave 2 Beam Plug In light **ON**)

- [] Close Cave 2 Inner Gate.

Attachment F: Cave 2 Chain Check

- [] Verify Cave 2 Safety Chain **COMPLETE** @ A2116 - Lt 31.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF** and Cave 2 Safety Chain OK light **ON**,
Cave 2 Beam Plug In light **ON**)

- [] Verify Cave 2 Safety Chain **DROPS** @ A2116 - Lt 39,
(Cave 2 Emergency Door Sw), when Emergency Door Open PB Switch
inside Cave 2 Door is pushed.
[Door should open after 8 second time delay]
- [] Verify Cave 2 Safety Chain **DROPS** @ A2116 - Lt 35,
(Cave 2 Door Closed), when Emergency Door Open PB Switch
time delay is complete and Cave 2 Door opens.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF** and Cave 2 Safety Chain OK light **OFF**,
Cave 2 Beam Plug In light **ON**)

Completed by: _____ Date: _____

Attachment G: Cave 3 Chain Check

PREPARATION FOR CAVE 3 CHAIN CHECK

Current copies of the following drawings are necessary to appreciate the function of each test:

Safety Chain Schematic Diagram, LBL 8W 6365 1/2 T
Beam Plug & Guillotine Control Schematic Diagram, LBL 8W 6975 P
Cave 2 and Cave 3 Door Controls Schematic Diagram, LBL 8W 8075 D
Redundant Chain, LBL 22W 4834

DISABLING THE CYCLOTRON

- [] Lock-out and Tag-out Circuit Breaker GE-50.
(GE-50 Kirk Key locked up with LoTo lock)

Completed by: _____ Date: _____

CAVE 3 CHAIN CHECK

(8W 6365 1/2 T, 8W 6975 P, 8W 8075 D, 22W 4834)

Requires 3 people, 3 radios

1 person inside Cave 3,
1 person outside Cave 3,
1 person in Control Room,

NOTE: This checklist assumes that the Main Safety Chain is **NOT** complete.

- [] Check radiation survey of Cave 3.
(Stay away from hot areas, practice ALARA)
- [] Make up Cave 3 with one person in cave.
- [] Remove Castell Key from Cave 3 Door Controls Panel.

Attachment G: Cave 3 Chain Check

- [] Verify Cave 3 Safety Chain **made up through** A2116 - Lt 43.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF** and Cave 3 Safety Chain OK light **OFF**,
Cave 3 Beam Plug In light **ON**)

- [] Verify Cave 3 Safety Chain **DROPS** @ A2116 - Lt 46,
(Cave 3 Door Key), when Cave 3 Castell Key is inserted
and turned clockwise at Cave 3 Door Controls Panel Q110.
- [] Cyclotron Redundant Radiation Safety Chain @ A1711 reads as above.

- [] Make up Cave 3 Safety Chain with one person in cave.
[Cave 3 Castell Key to A938 panel in Control Room]

- [] Verify Cave 3 Safety Chain **COMPLETE** @ A2116 - Lt 41.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF** and Cave 3 Safety Chain OK light **ON**,
Cave 3 Beam Plug In light **ON**)

- [] Verify Cave 3 Safety Chain **DROPS** @ A2116 - Lt 48,
(Cave 3 R/S Sw 1), when Run/Safe Switch at inspection reset box
QE 10 on upstream west cave wall, is moved to SAFE position.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF** and Cave 3 Safety Chain OK light **OFF**,
Cave 3 Beam Plug In light **ON**)

- [] Return Run/Safe Switch to RUN position.

- [] Verify Cave 3 Safety Chain **COMPLETE** @ A2116 - Lt 41.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF** and Cave 3 Safety Chain OK light **ON**,
Cave 3 Beam Plug In light **ON**)

- [] Verify Cave 3 Safety Chain **DROPS** @ A2116 - Lt 47,
(Cave 3 R/S Sw 2), when Run/Safe Switch at inspection reset box
QE 20 on downstream west cave wall, is moved to SAFE position.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF** and Cave 3 Safety Chain OK light **OFF**,
Cave 3 Beam Plug In light **ON**)

- [] Return Run/Safe Switch to RUN position.

Attachment G: Cave 3 Chain Check

- [] Verify Cave 3 Safety Chain **COMPLETE** @ A2116 - Lt 41.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF** and Cave 3 Safety Chain OK light **ON**,
Cave 3 Beam Plug In light **ON**)

- [] Verify Cave 3 Safety Chain **DROPS** @ A2116 - Lt 43,
(Cave 3 Door R/S Switch), when Run/Safe Switch at inspection reset
panel Q110 outside Cave 3 Door, is moved to SAFE position.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF** and Cave 3 Safety Chain OK light **OFF**,
Cave 3 Beam Plug In light **ON**)

- [] Return Run/Safe Switch to RUN position.

- [] Verify Cave 3 Safety Chain **COMPLETE** @ A2116 - Lt 41.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF** and Cave 3 Safety Chain OK light **ON**,
Cave 3 Beam Plug In light **ON**)

- [] Verify Cave 3 Safety Chain **DROPS** @ A2116 - Lt 42,
(Cave 3 Xfer Key In @ A938), when Cave 3 Castell Key
is removed from A938 Panel in Control Room.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF** and Cave 3 Safety Chain OK light **OFF**,
Cave 3 Beam Plug In light **ON**)

- [] Return Cave 3 Castell Key to fully engaged position in A938 Panel.

- [] Verify Cave 3 Safety Chain **COMPLETE** @ A2116 - Lt 41.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF** and Cave 3 Safety Chain OK light **ON**,
Cave 3 Beam Plug In light **ON**)

- [] Verify Cave 3 Safety Chain **DROPS** @ A2116 - Lt 44,
(Cave 3 Inner/Outer Gates), when Cave 3 Inner Gate is OPENED.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF** and Cave 3 Safety Chain OK light **OFF**,
Cave 3 Beam Plug In light **ON**)

- [] Close Cave 3 Inner Gate.

Attachment G: Cave 3 Chain Check

- [] Verify Cave 3 Safety Chain **COMPLETE** @ A2116 - Lt 41.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF** and Cave 3 Safety Chain OK light **ON**,
Cave 3 Beam Plug In light **ON**)

- [] Verify Cave 3 Safety Chain **DROPS** @ A2116 - Lt 49,
(Cave 3 Emergency Door Sw), when Emergency Door Open PB Switch
inside Cave 3 Door is pushed.
[Door should open after 8 second time delay]
- [] Verify Cave 3 Safety Chain **DROPS** @ A2116 - Lt 45,
(Cave 3 Door Closed), when Emergency Door Open PB Switch
time delay is complete and Cave 3 Door opens.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF** and Cave 3 Safety Chain OK light **OFF**,
Cave 3 Beam Plug In light **ON**)

Completed by: _____ Date: _____

Attachment H: Cave 4 Chain Check

PREPARATION FOR CAVE 4 CHAIN CHECK

Current copies of the following drawings are necessary to appreciate the function of each test:

Safety Chain Schematic Diagram, LBL 8W 6365 2/2 E
Beam Plug & Guillotine Control Schematic Diagram, LBL 8W 6975 P
Cave 4, 4A, 4B, 4C Door Controls Schematic Diagram, LBL 12W 5975 E
Cave 4 Electric Door Lock Control Schematic Diagram, LBL 12W 6381
Redundant Chain, LBL 22W 4834

DISABLING THE CYCLOTRON

- [] Lock-out and Tag-out Circuit Breaker GE-50.
(GE-50 Kirk Key locked up with LoTo lock)

Completed by: _____ Date: _____

CAVE 4 CHAIN CHECK

(8W 6365 2/2 E, 8W 6975 P, 12W 5975 D, 12W 6381, 22W 4834)

Requires 3 people, 3 radios

1 person inside Cave 4,
1 person outside Cave 4 in West Alley,
1 person in Control Room,

NOTE: This checklist assumes that the Main Safety Chain is **NOT** complete.

- [] Make up Cave 3 Safety Chain.
[Cave 3 Castell Key to A938 Panel in Control Room]
[] Verify Cave 3 Safety Chain **COMPLETE** @ A2116 - Lt 41.

Attachment H: Cave 4 Chain Check

- [] Check radiation survey of Cave 4.
(Stay away from hot areas, practice ALARA)
- [] Make up Cave 4 Safety Chain with one person in cave.
(Move Cave 4/4A Concrete Door all the way to Cave 4A closed position)
[You will need Caves 4 and 4A Castell Keys]
[Cave 4 Castell Key to A938 Panel in Control Room]
- [] Verify Cave 4 Safety Chain **COMPLETE** @ A2119 - Lt 7.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4 Safety Chain OK light **ON** and
Cave 4 Beam Plug In light **ON**)
- [] Verify G3A1 Chain in West Alley **COMPLETE** @ S1023 - Lt 1.
- [] Verify Cave 4 Chain in West Alley **COMPLETE** @ S1025 - Lt 1.
- [] Verify Cave 4 Safety Chain **DROPS** @ A2119 - Lt 8
(Cave 4 Xfer Key in @ A938), when Cave 4 Castell Key is removed
from A938 Panel in Control Room.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4 Safety Chain OK light **OFF** and
Cave 4 Beam Plug In light **ON**)
- [] Verify G3A1 Chain in West Alley **DROPS** @ S1023 - Lt 5
(Cave 4 Safe Cont. Rm. Xfr. Key).
- [] Verify Cave 4 Chain in West Alley remains **COMPLETE** @ S1025 - Lt 1.
- [] Return Cave 4 Castell Key to A938 Panel in Control Room.
- [] Verify Cave 4 Safety Chain **COMPLETE** @ A2119 - Lt 7.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4 Safety Chain OK light **ON** and
Cave 4 Beam Plug In light **ON**)
- [] Verify G3A1 Chain in West Alley **COMPLETE** @ S1023 - Lt 1.
- [] Verify Cave 4 Chain in West Alley **COMPLETE** @ S1025 - Lt 1.
- [] Verify Cave 4 Safety Chain **DROPS** @ A2119 - Lt 9
(Cave 4 Ready), when Run/Safe Switch at inspection reset box SE 91
on west cave wall, is moved to SAFE position.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4 Safety Chain OK light **OFF** and
Cave 4 Beam Plug In light **ON**)
- [] Verify G3A1 Chain in West Alley **DROPS** @ S1023 - Lt 5
(Cave 4 Safe Cont. Rm. Xfr. Key).

Attachment H: Cave 4 Chain Check

- [] Verify Cave 4 Chain in West Alley **DROPS** @ S1024 - Lt 8
(Safety Sw SE 91).
- [] Return Run/Safe Switch to RUN position.
- [] Verify Cave 4 Safety Chain **COMPLETE** @ A2119 - Lt 7.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4 Safety Chain OK light **ON** and
Cave 4 Beam Plug In light **ON**)
- [] Verify G3A1 Chain in West Alley **COMPLETE** @ S1023 - Lt 1.
- [] Verify Cave 4 Chain in West Alley **COMPLETE** @ S1025 - Lt 1.
- [] Verify Cave 4 Safety Chain **DROPS** @ A2119 - Lt 9
(Cave 4 Ready), when Run/Safe Switch at inspection reset box SE 101
on east cave wall, is moved to SAFE position.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4 Safety Chain OK light **OFF** and
Cave 4 Beam Plug In light **ON**)
- [] Verify G3A1 Chain in West Alley **DROPS** @ S1023 - Lt 5
(Cave 4 Safe Cont. Rm. Xfr. Key).
- [] Verify Cave 4 Chain in West Alley **DROPS** @ S1024 - Lt 7
(Safety Sw SE 101).
- [] Return Run/Safe Switch to RUN position.
- [] Verify Cave 4 Safety Chain **COMPLETE** @ A2119 - Lt 7.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4 Safety Chain OK light **ON** and
Cave 4 Beam Plug In light **ON**)
- [] Verify G3A1 Chain in West Alley **COMPLETE** @ S1023 - Lt 1.
- [] Verify Cave 4 Chain in West Alley **COMPLETE** @ S1025 - Lt 1.
- [] Verify Cave 4 Safety Chain **DROPS** @ A2119 - Lt 9
(Cave 4 Ready), when Run/Safe Switch at inspection reset panel S 710
at Cave 4 West Door Control Panel, is moved to SAFE position.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4 Safety Chain OK light **OFF** and
Cave 4 Beam Plug In light **ON**)
- [] Verify G3A1 Chain in West Alley **DROPS** @ S1023 - Lt 5
(Cave 4 Safe Cont. Rm. Xfr. Key).

Attachment H: Cave 4 Chain Check

- [] Verify Cave 4 Chain in West Alley **DROPS** @ S1024 - Lt 9 (Safety Sw S 710).
- [] Return Run/Safe Switch to RUN position.

- [] Verify Cave 4 Safety Chain **COMPLETE** @ A2119 - Lt 7.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads: (RF Permissive light **OFF**, Cave 4 Safety Chain OK light **ON** and Cave 4 Beam Plug In light **ON**)
- [] Verify G3A1 Chain in West Alley **COMPLETE** @ S1023 - Lt 1.
- [] Verify Cave 4 Chain in West Alley **COMPLETE** @ S1025 - Lt 1.

- [] Verify that *BEAM ON* lamp on Cave 4 East Swing Door is ON.
- [] OPEN Cave 4 East Swing Door.
- [] Verify that *BEAM ON* lamp on Cave 4 East Swing Door turns OFF.

- [] Verify Cave 4 Safety Chain **DROPS** @ A2119 - Lt 9 (Cave 4 Ready).
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads: (RF Permissive light **OFF**, Cave 4 Safety Chain OK light **OFF** and Cave 4 Beam Plug In light **ON**)
- [] Verify G3A1 Chain in West Alley **DROPS** @ S1023 - Lt 5 (Cave 4 Safe Cont. Rm. Xfr. Key).
- [] Verify Cave 4 Chain in West Alley **DROPS** @ S1024 - Lt 4 (Cave 4 East Swing Door).

- [] CLOSE Cave 4 East Swing Door.
- [] Verify that *BEAM ON* lamp on Cave 4 East Swing Door turns ON.

- [] Verify Cave 4 Safety Chain **COMPLETE** @ A2119 - Lt 7.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads: (RF Permissive light **OFF**, Cave 4 Safety Chain OK light **ON** and Cave 4 Beam Plug In light **ON**)
- [] Verify G3A1 Chain in West Alley **COMPLETE** @ S1023 - Lt 1.
- [] Verify Cave 4 Chain in West Alley **COMPLETE** @ S1025 - Lt 1.

- [] OPEN Cave 4/4A West Concrete Door by pressing Emergency Door Open PB Switch on inside west wall at Cave 4 West Concrete Door.
- [] Verify Cave 4/4A West Concrete Door starts to OPEN immediately.
- [] Verify Cave 4/4A West Concrete Door OPENS completely.

- [] Verify Cave 4 Safety Chain **DROPS** @ A2119 - Lt 9 (Cave 4 Ready).
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:

Attachment H: Cave 4 Chain Check

(RF Permissive light **OFF**, Cave 4 Safety Chain OK light **OFF** and Cave 4 Beam Plug In light **ON**)

- [] Verify G3A1 Chain in West Alley **DROPS** @ S1023 - Lt 5
(Cave 4 Safe Cont. Rm. Xfr. Key).
- [] Verify Cave 4 Chain in West Alley **DROPS** @ S1024 - Lt 5
(Cave 4 West Concrete Door).
- [] CLOSE Cave 4 West Concrete Door .
(Move Cave 4 Concrete Door only to Cave 4 closed position)
[Cave 4 Castell Key to A938 Panel in Control Room]
- [] Verify Cave 4 Safety Chain **COMPLETE** @ A2119 - Lt 7.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4 Safety Chain OK light **ON** and Cave 4 Beam Plug In light **ON**)
- [] Verify G3A1 Chain in West Alley **COMPLETE** @ S1023 - Lt 1.
- [] Verify Cave 4 Chain in West Alley **COMPLETE** @ S1025 - Lt 1.
- [] Verify Cave 4 Safety Chain **DROPS** @ A2119 - Lt 9
(Cave 4 Ready), when Run/Safe Switch at inspection reset panel S 610 at Cave 4 East Door Control Panel, is moved to SAFE position.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4 Safety Chain OK light **OFF** and Cave 4 Beam Plug In light **ON**)
- [] Verify G3A1 Chain in West Alley **DROPS** @ S1023 - Lt 5
(Cave 4 Safe Cont. Rm. Xfr. Key).
- [] Verify Cave 4 Chain in West Alley **DROPS** @ S1024 - Lt 6
(Safety Sw S 610).
- [] Return Run/Safe Switch to RUN position.
- [] Verify Cave 4 Safety Chain **COMPLETE** @ A2119 - Lt 7.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4 Safety Chain OK light **ON** and Cave 4 Beam Plug In light **ON**)
- [] Verify G3A1 Chain in West Alley **COMPLETE** @ S1023 - Lt 1.
- [] Verify Cave 4 Chain in West Alley **COMPLETE** @ S1025 - Lt 1.
- [] Verify Cave 4 Safety Chain **DROPS** @ A2119 - Lt 9 (Cave 4 Ready),
when Run/Safe Switch at inspection reset panel Q110 outside Cave 3

Attachment H: Cave 4 Chain Check

- Door is moved to SAFE position.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4 Safety Chain OK light **OFF** and
Cave 4 Beam Plug In light **ON**)
 - [] Verify G3A1 Chain in West Alley **DROPS** @ S1023 - Lt 9
(Cave 3 Safe).
 - [] Verify Cave 4 Chain in West Alley **DROPS** @ S1025 - Lt 10
(Cave 3 Ready).

 - [] Return Run/Safe Switch to RUN position.

 - [] Verify Cave 4 Safety Chain **COMPLETE** @ A2119 - Lt 7.
 - [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4 Safety Chain OK light **ON** and
Cave 4 Beam Plug In light **ON**)
 - [] Verify G3A1 Chain in West Alley **COMPLETE** @ S1023 - Lt 1.
 - [] Verify Cave 4 Chain in West Alley **COMPLETE** @ S1025 - Lt 1.

Completed by: _____ Date: _____

Attachment K: Cave 4A Chain Check

PREPARATION FOR CAVE 4A CHAIN CHECK

Current copies of the following drawings are necessary to appreciate the function of each test:

Safety Chain Schematic Diagram, LBL 8W 6365 2/2 E
Beam Plug & Guillotine Control Schematic Diagram, LBL 8W 6975 P
Cave 4, 4A, 4B, 4C Door Controls Schematic Diagram, LBL 12W 5975 E
Redundant Chain, LBL 22W 4834

DISABLING THE CYCLOTRON

- [] Lock-out and Tag-out Circuit Breaker GE-50.
(GE-50 Kirk Key locked up with LoTo lock)

Completed by: _____ Date: _____

CAVE 4A CHAIN CHECK

(8W 6365 2/2 E, 8W 6975 P, 12W 5975 D, 22W 4834)

Requires 3 people, 3 radios

1 person inside Cave 4A,
1 person outside Cave 4A in West Alley,
1 person in Control Room,

NOTE: This checklist assumes that the Main Safety Chain is **NOT** complete.

- [] Make up Cave 3 Safety Chain.
- [] Make up Cave 4 Safety Chain.
(Move Cave 4/4A Concrete Door all the way to Cave 4A closed position)
[You will need Caves 4 and 4A Castell Keys]
[Cave 3 Castell Key to A938 Panel in Control Room]
[Cave 4 Castell Key to A938 Panel in Control Room]

Attachment K: Cave 4A Chain Check

- [] Verify Cave 3 Safety Chain **COMPLETE** @ A2116 - Lt 41.
- [] Verify Cave 4 Safety Chain **COMPLETE** @ A2119 - Lt 7.
- [] Verify G3A1 Chain in West Alley **COMPLETE** @ S1023 - Lt 1.
- [] Verify Cave 4 Chain in West Alley **COMPLETE** @ S1025 - Lt 1.
(These last two chains should remain **COMPLETE** throughout a majority of this checklist)

- [] Check radiation survey of Cave 4A.
(Stay away from hot areas, practice ALARA)
- [] Make up Cave 4A Safety Chain with one person in cave.
[You may need Cave 4B Castell Key to close North 4A Concrete Door]
[Cave 4A Castell Key to A938 Panel in Control Room]

- [] Verify Cave 4A Safety Chain **COMPLETE** @ A2119 - Lt 1.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4A Safety Chain OK light **ON** and Cave 4A Beam Plug In light **ON**)
- [] Verify Cave 4A Chain in West Alley **COMPLETE** @ S1026 - Lt 1.

- [] Verify Cave 4A Safety Chain **DROPS** @ A2119 - Lt 2
(Cave 4A Xfer Key in @ A938), when Cave 4A Castell Key is removed from A938 Panel in Control Room.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4A Safety Chain OK light **OFF** and Cave 4A Beam Plug In light **ON**)

- [] Return Cave 4A Castell Key to A938 Panel in Control Room.

- [] Verify Cave 4A Safety Chain **COMPLETE** @ A2119 - Lt 1.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4A Safety Chain OK light **ON** and Cave 4A Beam Plug In light **ON**)
- [] Verify Cave 4A Chain in West Alley **COMPLETE** @ S1026 - Lt 1.

- [] Verify Cave 4A Safety Chain **DROPS** @ A2119 - Lt 3
(Cave 4A Ready), when Run/Safe Switch at inspection reset box SE 80 on West inside cave wall, is moved to SAFE position.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4A Safety Chain OK light **OFF** and Cave 4A Beam Plug In light **ON**)
- [] Verify Cave 4A Chain in West Alley **DROPS** @ S1026 - Lt 8.

Attachment K: Cave 4A Chain Check

- (Safety Switch SE 80)
- [] Return Run/Safe Switch to RUN position.

 - [] Verify Cave 4A Safety Chain **COMPLETE** @ A2119 - Lt 1.
 - [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4A Safety Chain OK light **ON** and
Cave 4A Beam Plug In light **ON**)
 - [] Verify Cave 4A Chain in West Alley **COMPLETE** @ S1026 - Lt 1.

 - [] Verify Cave 4A Safety Chain **DROPS** @ A2119 - Lt 3
(Cave 4A Ready), when Run/Safe Switch at inspection reset box SE 31
on S11 rack to the east, is moved to SAFE position.
 - [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4A Safety Chain OK light **OFF** and
Cave 4A Beam Plug In light **ON**)
 - [] Verify Cave 4A Chain in West Alley **DROPS** @ S1026 - Lt 7.
(Safety Switch SE 31)

 - [] Return Run/Safe Switch to RUN position.

 - [] Verify Cave 4A Safety Chain **COMPLETE** @ A2119 - Lt 1.
 - [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4A Safety Chain OK light **ON** and
Cave 4A Beam Plug In light **ON**)
 - [] Verify Cave 4A Chain in West Alley **COMPLETE** @ S1026 - Lt 1.

 - [] Verify Cave 4A Safety Chain **DROPS** @ A2119 - Lt 3
(Cave 4A Ready), when Run/Safe Switch at inspection reset box SE 70
on North inside cave wall, is moved to SAFE position.
 - [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4A Safety Chain OK light **OFF** and
Cave 4A Beam Plug In light **ON**)
 - [] Verify Cave 4A Chain in West Alley **DROPS** @ S1026 - Lt 6.
(Safety Switch SE 70)

 - [] Return Run/Safe Switch to RUN position.

 - [] Verify Cave 4A Safety Chain **COMPLETE** @ A2119 - Lt 1.
 - [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4A Safety Chain OK light **ON** and
Cave 4A Beam Plug In light **ON**)

Attachment K: Cave 4A Chain Check

- [] Verify Cave 4A Chain in West Alley **COMPLETE** @ S1026 - Lt 1.
- [] OPEN Cave 4A West Concrete Door by pressing Emergency Door Open PB Switch on inside west wall at Cave 4A West Concrete Door.
- [] Verify Cave 4A West Concrete Door starts to OPEN immediately.
- [] Verify Cave 4A West Concrete Door OPENS completely to Cave 4 limit.
- [] Verify Cave 4A Safety Chain **DROPS** @ A2119 - Lt 3 (Cave 4A Ready).
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads: (RF Permissive light **OFF**, Cave 4A Safety Chain OK light **OFF** and Cave 4A Beam Plug In light **ON**)
- [] Verify Cave 4A Chain in West Alley **DROPS** @ S1026 - Lt 4. (Cave 4A West Concrete Door)
- [] CLOSE Cave 4A West Concrete Door (with person inside Cave 4A) .
[You may need Cave 4 Castell Key to close West 4A Concrete Door]
[Cave 4A (and 4) Castell Key(s) to A938 Panel in Control Room]
- [] Verify Cave 4A Safety Chain **COMPLETE** @ A2119 - Lt 1.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads: (RF Permissive light **OFF**, Cave 4A Safety Chain OK light **ON** and Cave 4A Beam Plug In light **ON**)
- [] Verify Cave 4A Chain in West Alley **COMPLETE** @ S1026 - Lt 1.
- [] OPEN Cave 4A North Concrete Door by pressing Emergency Door Open PB Switch on inside north wall at Cave 4A North Concrete Door.
- [] Verify Cave 4A North Concrete Door starts to OPEN immediately.
- [] Verify Cave 4A North Concrete Door OPENS completely to Cave 4B limit.
- [] Verify Cave 4A Safety Chain **DROPS** @ A2119 - Lt 3 (Cave 4A Ready).
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads: (RF Permissive light **OFF**, Cave 4A Safety Chain OK light **OFF** and Cave 4A Beam Plug In light **ON**)
- [] Verify Cave 4A Chain in West Alley **DROPS** @ S1026 - Lt 3. (Cave 4A North Concrete Door)
- [] CLOSE Cave 4A North Concrete Door. (No key needed to close door)
[You may need Cave 4B Castell Key to close North 4A Concrete Door]
- [] Verify Cave 4A Safety Chain **COMPLETE** @ A2119 - Lt 1.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:

Attachment K: Cave 4A Chain Check

- (RF Permissive light **OFF**, Cave 4A Safety Chain OK light **ON** and Cave 4A Beam Plug In light **ON**)
- [] Verify Cave 4A Chain in West Alley **COMPLETE** @ S1026 - Lt 1.
 - [] Verify Cave 4A Safety Chain **DROPS** @ A2119 - Lt 3
(Cave 4A Ready), when Run/Safe Switch at inspection reset panel S110 outside Cave 4A West Door, is moved to SAFE position.
 - [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4A Safety Chain OK light **OFF** and Cave 4A Beam Plug In light **ON**)
 - [] Verify Cave 4A Chain in West Alley **DROPS** @ S1026 - Lt 9.
(Safety Switch S110)
 - [] Return Run/Safe Switch to RUN position.
 - [] Verify Cave 4A Safety Chain **COMPLETE** @ A2119 - Lt 1.
 - [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4A Safety Chain OK light **ON** and Cave 4A Beam Plug In light **ON**)
 - [] Verify Cave 4A Chain in West Alley **COMPLETE** @ S1026 - Lt 1.
 - [] Verify Cave 4A Safety Chain **DROPS** @ A2119 - Lt 3
(Cave 4A Ready), when Run/Safe Switch at inspection reset panel S310 outside Cave 4A North Door, is moved to SAFE position.
 - [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4A Safety Chain OK light **OFF** and Cave 4A Beam Plug In light **ON**)
 - [] Verify Cave 4A Chain in West Alley **DROPS** @ S1026 - Lt 5.
(Safety Switch S310)
 - [] Return Run/Safe Switch to RUN position.
 - [] Verify Cave 4A Safety Chain **COMPLETE** @ A2119 - Lt 1.
 - [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4A Safety Chain OK light **ON** and Cave 4A Beam Plug In light **ON**)
 - [] Verify Cave 4A Chain in West Alley **COMPLETE** @ S1026 - Lt 1.
 - [] Verify Cave 4A Safety Chain **DROPS** @ A2119 - Lt 3
(Cave 4A Ready), when Run/Safe Switch at inspection reset panel S610 at Cave 4 East Door Control Panel, is moved to SAFE position.
 - [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:

Attachment K: Cave 4A Chain Check

- (RF Permissive light **OFF**, Cave 4A Safety Chain OK light **OFF** and Cave 4A Beam Plug In light **ON**)
- [] Verify Cave 4A Chain in West Alley **DROPS** @ S1026 - Lt 2.
(Cave 4 Ready)
 - [] Return Run/Safe Switch to RUN position.

 - [] Verify Cave 4A Safety Chain **COMPLETE** @ A2119 - Lt 1.
 - [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4A Safety Chain OK light **ON** and Cave 4A Beam Plug In light **ON**)
 - [] Verify Cave 4A Chain in West Alley **COMPLETE** @ S1026 - Lt 1.

 - [] Verify Cave 4A Safety Chain **DROPS** @ A2119 - Lt 3
(Cave 4A Ready), when Run/Safe Switch at inspection reset panel Q110 outside Cave 3 Door, is moved to SAFE position.
 - [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4A Safety Chain OK light **OFF** and Cave 4A Beam Plug In light **ON**)
 - [] Verify Cave 4A Chain in West Alley **DROPS** @ S1026 - Lt 1.
(Cave 3 Ready and Cave 4A Ready)

 - [] Return Run/Safe Switch to RUN position.

 - [] Verify Cave 4A Safety Chain **COMPLETE** @ A2119 - Lt 1.
 - [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4A Safety Chain OK light **ON** and Cave 4A Beam Plug In light **ON**)
 - [] Verify Cave 4A Chain in West Alley **COMPLETE** @ S1026 - Lt 1.

Completed by: _____ Date: _____

Attachment M: Cave 4B Chain Check

PREPARATION FOR CAVE 4B CHAIN CHECK

Current copies of the following drawings are necessary to appreciate the function of each test:

Safety Chain Schematic Diagram, LBL 8W 6365 2/2 E
Beam Plug & Guillotine Control Schematic Diagram, LBL 8W 6975 P
Cave 4, 4A, 4B, 4C Door Controls Schematic Diagram, LBL 12W 5975 E
Redundant Chain, LBL 22W 4834

DISABLING THE CYCLOTRON

- [] Lock-out and Tag-out Circuit Breaker GE-50.
(GE-50 Kirk Key locked up with LoTo lock)

Completed by: _____ Date: _____

CAVE 4B CHAIN CHECK

(8W 6365 2/2 E, 8W 6975 P, 12W 5975 D, 22W 4834)

Requires 3 people, 3 radios

1 person inside Cave 4B,
1 person at S10 rack in West Alley,
1 person in Control Room,

NOTE: This checklist assumes that the Main Safety Chain is **NOT** complete.

- [] Make up Cave 3 Safety Chain.
- [] Make up Cave 4 Safety Chain.
[Cave 3 Castell Key to A938 Panel in Control Room]
[Cave 4 Castell Key to A938 Panel in Control Room]

Attachment M: Cave 4B Chain Check

- [] Verify Cave 3 Safety Chain **COMPLETE** @ A2116 - Lt 41.
- [] Verify Cave 4 Safety Chain **COMPLETE** @ A2119 - Lt 7.
- [] Verify G3A1 Chain in West Alley **COMPLETE** @ S1023 - Lt 1.
- [] Verify Cave 4 Chain in West Alley **COMPLETE** @ S1025 - Lt 1.
(These last two chains should remain **COMPLETE** throughout a majority of this checklist)

- [] Check radiation survey of Cave 4B.
(Stay away from hot areas, practice ALARA)
- [] Make up Cave 4B Safety Chain with one person in cave.
[You may need Cave 4A Castell Key to close 4B Concrete Door]
[Cave 4B Castell Key to A938 Panel in Control Room]

- [] Verify Cave 4B Safety Chain **COMPLETE** @ A2121 - Lt 7.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4B Safety Chain OK light **ON** and Cave 4B Beam Plug In light **ON**)
- [] Verify Cave 4B Chain in West Alley **COMPLETE** @ S1027 - Lt 1.

- [] Verify Cave 4B Safety Chain **DROPS** @ A2121 - Lt 8
(Cave 4B Xfer Key in @ A938), when Cave 4B Castell Key is removed from A938 Panel in Control Room.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4B Safety Chain OK light **OFF** and Cave 4B Beam Plug In light **ON**)

- [] Return Cave 4B Castell Key to A938 Panel in Control Room.

- [] Verify Cave 4B Safety Chain **COMPLETE** @ A2121 - Lt 7.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4B Safety Chain OK light **ON** and Cave 4B Beam Plug In light **ON**)
- [] Verify Cave 4B Chain in West Alley **COMPLETE** @ S1027 - Lt 1.

- [] Verify Cave 4B Safety Chain **DROPS** @ A2121 - Lt 9
(Cave 4B Ready), when Run/Safe Switch at inspection reset box SE 61 on north cave wall, is moved to SAFE position.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4B Safety Chain OK light **OFF** and Cave 4B Beam Plug In light **ON**)
- [] Verify Cave 4B Chain in West Alley **DROPS** @ S1027 - Lt 8.

Attachment M: Cave 4B Chain Check

- (Safety Switch SE 61)
- [] Return Run/Safe Switch to RUN position.
 - [] Verify Cave 4B Safety Chain **COMPLETE** @ A2121 - Lt 7.
 - [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4B Safety Chain OK light **ON** and
Cave 4B Beam Plug In light **ON**)
 - [] Verify Cave 4B Chain in West Alley **COMPLETE** @ S1027 - Lt 1.
 - [] OPEN Cave 4B Concrete Door by pressing Emergency Door
Open PB Switch on inside north wall at Cave 4B Concrete Door.
 - [] Verify Cave 4B Concrete Door starts to OPEN immediately.
 - [] Verify Cave 4B Concrete Door OPENS completely to Cave 4A limit.
 - [] Verify Cave 4B Safety Chain **DROPS** @ A2121 - Lt 9 (Cave 4B Ready).
 - [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4B Safety Chain OK light **OFF** and
Cave 4B Beam Plug In light **ON**)
 - [] Verify Cave 4B Chain in West Alley **DROPS** @ S1027 - Lt 6.
(Cave 4B Concrete Door)
 - [] CLOSE Cave 4B Concrete Door. (No key needed to close door)
[You may need Cave 4A Castell Key to close 4B Concrete Door]
 - [] Verify Cave 4B Safety Chain **COMPLETE** @ A2121 - Lt 7.
 - [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4B Safety Chain OK light **ON** and
Cave 4B Beam Plug In light **ON**)
 - [] Verify Cave 4B Chain in West Alley **COMPLETE** @ S1027 - Lt 1.
 - [] Verify Cave 4B Safety Chain **DROPS** @ A2121 - Lt 9
(Cave 4B Ready), when Run/Safe Switch at inspection reset panel S410
outside Cave 4B Door, is moved to SAFE position.
 - [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4B Safety Chain OK light **OFF** and
Cave 4B Beam Plug In light **ON**)
 - [] Verify Cave 4B Chain in West Alley **DROPS** @ S1027 - Lt 9.
(Safety Switch S410)
 - [] Return Run/Safe Switch to RUN position.

Attachment M: Cave 4B Chain Check

- [] Verify Cave 4B Safety Chain **COMPLETE** @ A2121 - Lt 7.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4B Safety Chain OK light **ON** and
Cave 4B Beam Plug In light **ON**)
- [] Verify Cave 4B Chain in West Alley **COMPLETE** @ S1027 - Lt 1.
- [] Verify Cave 4B Safety Chain **DROPS** @ A2121 - Lt 7
(Cave 4B Ready), when Run/Safe Switch at inspection reset panel S610
at Cave 4 East Door Control Panel, is moved to SAFE position.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4B Safety Chain OK light **OFF** and
Cave 4B Beam Plug In light **ON**)
- [] Verify Cave 4B Chain in West Alley **DROPS** @ S1027 - Lt 5.
(Cave 4 Ready)
- [] Return Run/Safe Switch to RUN position.
- [] Verify Cave 4B Safety Chain **COMPLETE** @ A2121 - Lt 7.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4B Safety Chain OK light **ON** and
Cave 4B Beam Plug In light **ON**)
- [] Verify Cave 4B Chain in West Alley **COMPLETE** @ S1027 - Lt 1.
- [] Verify Cave 4B Safety Chain **DROPS** @ A2121 - Lt 7
(Cave 4B Ready), when Run/Safe Switch at inspection reset panel Q110
outside Cave 3 Door, is moved to SAFE position.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4B Safety Chain OK light **OFF** and
Cave 4B Beam Plug In light **ON**)
- [] Verify Cave 4B Chain in West Alley **DROPS** @ S1027 - Lt 4.
(Cave 3 Ready)
- [] Return Run/Safe Switch to RUN position.
- [] Verify Cave 4B Safety Chain **COMPLETE** @ A2121 - Lt 7.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4B Safety Chain OK light **ON** and
Cave 4B Beam Plug In light **ON**)
- [] Verify Cave 4B Chain in West Alley **COMPLETE** @ S1027 - Lt 1.

Attachment M: Cave 4B Chain Check

Completed by: _____ Date: _____

Attachment N: Cave 4C Chain Check

PREPARATION FOR CAVE 4C CHAIN CHECK

Current copies of the following drawings are necessary to appreciate the function of each test:

Safety Chain Schematic Diagram, LBL 8W 6365 2/2 E
Beam Plug & Guillotine Control Schematic Diagram, LBL 8W 6975 P
Cave 4, 4A, 4B, 4C Door Controls Schematic Diagram, LBL 12W 5975 E
Redundant Chain, LBL 22W 4834

DISABLING THE CYCLOTRON

- [] Lock-out and Tag-out Circuit Breaker GE-50.
(GE-50 Kirk Key locked up with LoTo lock)

Completed by: _____ Date: _____

CAVE 4C CHAIN CHECK

(8W 6365 2/2 E, 8W 6975 P, 12W 5975 D, 22W 4834)

Requires 3 people, 3 radios

1 person inside Cave 4C,
1 person outside Cave 4C (in West Alley),
1 person in Control Room,

NOTE: This checklist assumes that the Main Safety Chain is **NOT** complete.

- [] Make up Cave 3 Safety Chain.
- [] Make up Cave 4 Safety Chain.
[Cave 3 Castell Key to A938 Panel in Control Room]
[Cave 4 Castell Key to A938 Panel in Control Room]

Attachment N: Cave 4C Chain Check

- [] Verify Cave 3 Safety Chain **COMPLETE** @ A2116 - Lt 41.
- [] Verify Cave 4 Safety Chain **COMPLETE** @ A2119 - Lt 7.
- [] Verify G3A1 Chain in West Alley **COMPLETE** @ S1023 - Lt 1.
- [] Verify Cave 4 Chain in West Alley **COMPLETE** @ S1025 - Lt 1.
(These last two chains should remain **COMPLETE** throughout a majority of this checklist)

- [] Check radiation survey of Cave 4C.
(Stay away from hot areas, practice ALARA)
- [] Make up Cave 4C Safety Chain with one person in cave.
[Cave 4C Castell Key to A938 Panel in Control Room]

- [] Verify Cave 4C Safety Chain **COMPLETE** @ A2121 - Lt 1.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4C Safety Chain OK light **ON** and Cave 4C Beam Plug In light **ON**)
- [] Verify Cave 4C Chain in West Alley **COMPLETE** @ S1028 - Lt 1.

- [] Verify Cave 4C Safety Chain **DROPS** @ A2121 - Lt 2
(Cave 4C Xfer Key in @ A938), when Cave 4C Castell Key is removed from A938 Panel in Control Room.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4C Safety Chain OK light **OFF** and Cave 4C Beam Plug In light **ON**)

- [] Return Cave 4C Castell Key to A938 Panel in Control Room.

- [] Verify Cave 4C Safety Chain **COMPLETE** @ A2121 - Lt 1.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4C Safety Chain OK light **ON** and Cave 4C Beam Plug In light **ON**)
- [] Verify Cave 4C Chain in West Alley **COMPLETE** @ S1028 - Lt 1.

- [] Verify Cave 4C Safety Chain **DROPS** @ A2121 - Lt 3
(Cave 4C Ready), when Run/Safe Switch at inspection reset box SE 41 on South inside cave wall, is moved to SAFE position.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4C Safety Chain OK light **OFF** and Cave 4C Beam Plug In light **ON**)

- [] Verify Cave 4C Chain in West Alley **DROPS** @ S1028 - Lt 8.

Attachment N: Cave 4C Chain Check

- (Safety Switch SE 41)
- [] Return Run/Safe Switch to RUN position.
- [] Verify Cave 4C Safety Chain **COMPLETE** @ A2121 - Lt 1.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4C Safety Chain OK light **ON** and
Cave 4C Beam Plug In light **ON**)
- [] Verify Cave 4C Chain in West Alley **COMPLETE** @ S1028 - Lt 1.
- [] Verify Cave 4C Safety Chain **DROPS** @ A2121 - Lt 3
(Cave 4C Ready), when Run/Safe Switch at inspection reset box SE 51
on Northwest inside cave wall, is moved to SAFE position.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4C Safety Chain OK light **OFF** and
Cave 4C Beam Plug In light **ON**)
- [] Verify Cave 4C Chain in West Alley **DROPS** @ S1028 - Lt 7.
(Safety Switch SE 51)
- [] Return Run/Safe Switch to RUN position.
- [] Verify Cave 4C Safety Chain **COMPLETE** @ A2121 - Lt 1.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4C Safety Chain OK light **ON** and
Cave 4C Beam Plug In light **ON**)
- [] Verify Cave 4C Chain in West Alley **COMPLETE** @ S1028 - Lt 1.
- [] OPEN Cave 4C South Swing Door
- [] Verify Cave 4C Safety Chain **DROPS** @ A2121 - Lt 3 (Cave 4C Ready).
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4C Safety Chain OK light **OFF** and
Cave 4C Beam Plug In light **ON**)
- [] Verify Cave 4C Chain in West Alley **DROPS** @ S1028 - Lt 5.
(Cave 4C South Swing Door)
- [] CLOSE Cave 4C South Swing Door .
- [] Verify Cave 4C Safety Chain **COMPLETE** @ A2121 - Lt 1.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4C Safety Chain OK light **ON** and
Cave 4C Beam Plug In light **ON**)

Attachment N: Cave 4C Chain Check

- [] Verify Cave 4C Chain in West Alley **COMPLETE** @ S1028 - Lt 1.
- [] OPEN Cave 4C North Concrete Door by pressing Emergency Door Open PB Switch on inside north wall at Cave 4C North Concrete Door.
- [] Verify Cave 4C North Concrete Door starts to OPEN immediately.
- [] Verify Cave 4C North Concrete Door OPENS completely.
- [] Verify Cave 4C Safety Chain **DROPS** @ A2121 - Lt 3 (Cave 4C Ready).
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads: (RF Permissive light OFF, Cave 4C Safety Chain OK light OFF and Cave 4C Beam Plug In light **ON**)
- [] Verify Cave 4C Chain in West Alley **DROPS** @ S1028 - Lt 4. (Cave 4C North Concrete Door)
- [] CLOSE Cave 4C North Concrete Door. (No key needed to close door)
- [] Verify Cave 4C Safety Chain **COMPLETE** @ A2121 - Lt 1.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads: (RF Permissive light OFF, Cave 4C Safety Chain OK light **ON** and Cave 4C Beam Plug In light **ON**)
- [] Verify Cave 4C Chain in West Alley **COMPLETE** @ S1028 - Lt 1.
- [] Verify Cave 4C Safety Chain **DROPS** @ A2121 - Lt 3 (Cave 4C Ready), when Run/Safe Switch at inspection reset panel S510 outside Cave 4C North Door, is moved to SAFE position.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads: (RF Permissive light OFF, Cave 4C Safety Chain OK light OFF and Cave 4C Beam Plug In light **ON**)
- [] Verify Cave 4C Chain in West Alley **DROPS** @ S1028 - Lt 6. (Safety Switch S510)
- [] Return Run/Safe Switch to RUN position.
- [] Verify Cave 4C Safety Chain **COMPLETE** @ A2121 - Lt 1.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads: (RF Permissive light OFF, Cave 4C Safety Chain OK light **ON** and Cave 4C Beam Plug In light **ON**)
- [] Verify Cave 4C Chain in West Alley **COMPLETE** @ S1028 - Lt 1.
- [] Verify Cave 4C Safety Chain **DROPS** @ A2121 - Lt 3 (Cave 4C Ready), when Run/Safe Switch at inspection reset panel S210

Attachment N: Cave 4C Chain Check

outside Cave 4C South Swing Door, is moved to SAFE position.

- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4C Safety Chain OK light **OFF** and
Cave 4C Beam Plug In light **ON**)
- [] Verify Cave 4C Chain in West Alley **DROPS** @ S1028 - Lt 9.
(Safety Switch S210)
- [] Return Run/Safe Switch to RUN position.
- [] Verify Cave 4C Safety Chain **COMPLETE** @ A2121 - Lt 1.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4C Safety Chain OK light **ON** and
Cave 4C Beam Plug In light **ON**)
- [] Verify Cave 4C Chain in West Alley **COMPLETE** @ S1028 - Lt 1.
- [] Verify Cave 4C Safety Chain **DROPS** @ A2121 - Lt 1
(Cave 4C Ready), when Run/Safe Switch at inspection reset panel S610
at Cave 4 East Door Control Panel, is moved to SAFE position.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4C Safety Chain OK light **OFF** and
Cave 4C Beam Plug In light **ON**)
- [] Verify Cave 4C Chain in West Alley **DROPS** @ S1028 - Lt 3.
(Cave 4 Ready)
- [] Return Run/Safe Switch to RUN position.
- [] Verify Cave 4C Safety Chain **COMPLETE** @ A2121 - Lt 1.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4C Safety Chain OK light **ON** and
Cave 4C Beam Plug In light **ON**)
- [] Verify Cave 4C Chain in West Alley **COMPLETE** @ S1028 - Lt 1.
- [] Verify Cave 4C Safety Chain **DROPS** @ A2121 - Lt 3
(Cave 4C Ready), when Run/Safe Switch at inspection reset panel Q110
outside Cave 3 Door, is moved to SAFE position.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4C Safety Chain OK light **OFF** and
Cave 4C Beam Plug In light **ON**)
- [] Verify Cave 4C Chain in West Alley **DROPS** @ S1028 - Lt 2.

Attachment N: Cave 4C Chain Check

(Cave 3 Ready)

- [] Return Run/Safe Switch to RUN position.

- [] Verify Cave 4C Safety Chain **COMPLETE** @ A2121 - Lt 1.
- [] Verify Cyclotron Redundant Radiation Safety Chain @ A1711 reads:
(RF Permissive light **OFF**, Cave 4C Safety Chain OK light **ON** and
Cave 4C Beam Plug In light **ON**)
- [] Verify Cave 4C Chain in West Alley **COMPLETE** @ S1028 - Lt 1.

Completed by: _____ Date: _____

88-PROCEDURE-001 Version-2.0 Safety Interlock System Chain Check Procedure

Attachment P: CAVE BEAM PLUG Chain Check

PREPARATION FOR CAVE BEAM PLUG CHECKS

Current copies of the following drawings are necessary to appreciate the function of each test:

Safety Chain Schematic Diagram, LBL 8W 6365 1/2 T, 2/2 E
Beam Plug & Guillotine Control Schematic Diagram, LBL 8W 6975 P
Redundant Chain, LBL 22W 4834

Requires 3 people, 3 radios

2 people outside Caves,
1 person in Control Room,

[] Make up Main Safety Chain (Vault, Pit and Trench).

[] Verify Main Safety Chain (Vault, Pit and Trench) is made up.

Completed by: _____ Date: _____

88-PROCEDURE-001 Version-2.0 Safety Interlock System Chain Check Procedure

Attachment P: CAVE BEAM PLUG Chain Check

Cave 0 Beam Plug Check

- [] Make up Cave 0 Safety Chain.
[Cave 0 Castell Key to A938 Panel in Control Room]
- [] Open beam plug to Cave 0. (Takes about 30 seconds)
- [] Verify Main Safety Chain **COMPLETE** @ A2116 - Lt 1.
- [] Verify Cave 0 Safety Chain **COMPLETE** @ A2116 - Lt 11.
- [] Verify Cyclotron Redundant Radiation Safety Chain
COMPLETE to RF Permissive light @ A1711.
(RF Permissive light **ON** and Cave 0 Safety Chain OK light **ON**,
Cave 0 Beam Plug In light **OFF**)
- [] Move Run/Safe Switch at Cave 0 Door Controls Panel M110
(Cave 0 Door R/S Switch) to the SAFE position.
- [] Verify Main Safety Chain **DROPS immediately** @ A2111 - Lt 43.
- [] Verify Cave 0 Safety Chain **DROPS immediately** @ A2116 - Lt 15.
- [] Verify Cyclotron Redundant Radiation Safety Chain **DROPS immediately** @ A1711.
(RF Permissive light **OFF** and Cave 0 Safety Chain OK light **OFF**,
Cave 0 Beam Plug In light **OFF**)
- [] Verify that beam plug closes automatically.
- [] Verify Main Safety Chain **COMPLETE** @ A2116 - Lt 1,
when beam plug actuator operates beam plug closed switch.
- [] Verify Cyclotron Redundant Radiation Safety Chain
COMPLETE to RF Permissive light @ A1711,
when beam plug actuator operates beam plug closed switch.
(RF Permissive light **ON** and Cave 0 Beam Plug In light **ON**,
Cave 0 Cave Safety Chain OK light **OFF**)
- [] Return Run/Safe Switch to RUN position.
- [] Verify Main Safety Chain remains **COMPLETE** @ A2116 - Lt 1.
- [] Verify Cave 0 Safety Chain **COMPLETE** @ A2116 - Lt 11.
- [] Verify Cyclotron Redundant Radiation Safety Chain
remains **COMPLETE** to RF Permissive light @ A1711.
(RF Permissive light **ON** and Cave 0 Beam Plug In light **ON**,
Cave 0 Cave Safety Chain OK light **ON**)

Completed by: _____ Date: _____

88-PROCEDURE-001 Version-2.0 Safety Interlock System Chain Check Procedure

Attachment P: CAVE BEAM PLUG Chain Check

Cave 1 Beam Plug Check

- [] Make up Cave 1 Safety Chain.
[Cave 1 Castell Key to A938 Panel in Control Room]

- [] Open beam plug to Cave 1. (Takes about 30 seconds)

- [] Verify Main Safety Chain **COMPLETE** @ A2116 - Lt 1.
- [] Verify Cave 1 Safety Chain **COMPLETE** @ A2116 - Lt 21.
- [] Verify Cyclotron Redundant Radiation Safety Chain
COMPLETE to RF Permissive light @ A1711.
(RF Permissive light **ON** and Cave 1 Safety Chain OK light **ON**,
Cave 1 Beam Plug In light **OFF**)

- [] Move Run/Safe Switch at Cave 1 Door Controls Panel N110
(Cave 1 Door R/S Switch) to the SAFE position.

- [] Verify Main Safety Chain **DROPS immediately** @ A2111 - Lt 42.
- [] Verify Cave 1 Safety Chain **DROPS immediately** @ A2116 - Lt 25.
- [] Verify Cyclotron Redundant Radiation Safety Chain **DROPS immediately** @ A1711.
(RF Permissive light **OFF** and Cave 1 Safety Chain OK light **OFF**,
Cave 1 Beam Plug In light **OFF**)

- [] Verify that beam plug closes automatically.

- [] Verify Main Safety Chain **COMPLETE** @ A2116 - Lt 1,
when beam plug actuator operates beam plug closed switch.

- [] Verify Cyclotron Redundant Radiation Safety Chain
COMPLETE to RF Permissive light @ A1711,
when beam plug actuator operates beam plug closed switch.
(RF Permissive light **ON** and Cave 1 Beam Plug In light **ON**,
Cave 1 Cave Safety Chain OK light **OFF**)

- [] Return Run/Safe Switch to RUN position.

- [] Verify Main Safety Chain remains **COMPLETE** @ A2116 - Lt 1.

- [] Verify Cave 1 Safety Chain **COMPLETE** @ A2116 - Lt 21.

- [] Verify Cyclotron Redundant Radiation Safety Chain
remains **COMPLETE** to RF Permissive light @ A1711.
(RF Permissive light **ON** and Cave 1 Beam Plug In light **ON**,
Cave 1 Cave Safety Chain OK light **ON**)

Completed by: _____ Date: _____

88-PROCEDURE-001 Version-2.0 Safety Interlock System Chain Check Procedure

Attachment P: CAVE BEAM PLUG Chain Check

Cave 2 Beam Plug Check

- [] Make up Cave 2 Safety Chain.
[Cave 2 Castell Key to A938 Panel in Control Room]
- [] Open beam plug to Cave 2. (Takes about 30 seconds)
- [] Verify Main Safety Chain **COMPLETE** @ A2116 - Lt 1.
- [] Verify Cave 2 Safety Chain **COMPLETE** @ A2116 - Lt 31.
- [] Verify Cyclotron Redundant Radiation Safety Chain
COMPLETE to RF Permissive light @ A1711.
(RF Permissive light **ON** and Cave 2 Safety Chain OK light **ON**,
Cave 2 Beam Plug In light **OFF**)
- [] Move Run/Safe Switch at Cave 2 Door Controls Panel P110
(Cave 2 Door R/S Switch) to the SAFE position.
- [] Verify Main Safety Chain **DROPS immediately** @ A2111 - Lt 41.
- [] Verify Cave 2 Safety Chain **DROPS immediately** @ A2116 - Lt 33.
- [] Verify Cyclotron Redundant Radiation Safety Chain **DROPS immediately** @ A1711.
(RF Permissive light **OFF** and Cave 2 Safety Chain OK light **OFF**,
Cave 2 Beam Plug In light **OFF**)
- [] Verify that beam plug closes automatically.
- [] Verify Main Safety Chain **COMPLETE** @ A2116 - Lt 1,
when beam plug actuator operates beam plug closed switch.
- [] Verify Cyclotron Redundant Radiation Safety Chain
COMPLETE to RF Permissive light @ A1711,
when beam plug actuator operates beam plug closed switch.
(RF Permissive light **ON** and Cave 2 Beam Plug In light **ON**,
Cave 2 Cave Safety Chain OK light **OFF**)
- [] Return Run/Safe Switch to RUN position.
- [] Verify Main Safety Chain remains **COMPLETE** @ A2116 - Lt 1.
- [] Verify Cave 2 Safety Chain **COMPLETE** @ A2116 - Lt 31.
- [] Verify Cyclotron Redundant Radiation Safety Chain
remains **COMPLETE** to RF Permissive light @ A1711.
(RF Permissive light **ON** and Cave 2 Beam Plug In light **ON**,
Cave 2 Cave Safety Chain OK light **ON**)

Completed by: _____ Date: _____

88-PROCEDURE-001 Version-2.0 Safety Interlock System Chain Check Procedure

Attachment P: CAVE BEAM PLUG Chain Check

Cave 3 Beam Plug Check

- [] Make up Cave 3 Safety Chain.
[Cave 3 Castell Key to A938 Panel in Control Room]
- [] Open beam plug to Cave 3. (Takes about 30 seconds)
- [] Verify Main Safety Chain **COMPLETE** @ A2116 - Lt 1.
- [] Verify Cave 3 Safety Chain **COMPLETE** @ A2116 - Lt 41.
- [] Verify Cyclotron Redundant Radiation Safety Chain
COMPLETE to RF Permissive light @ A1711.
(RF Permissive light **ON** and Cave 3 Safety Chain OK light **ON**,
Cave 3 Beam Plug In light **OFF**)
- [] Move Run/Safe Switch at Cave 3 Door Controls Panel Q110
(Cave 3 Door R/S Switch) to the SAFE position.
- [] Verify Main Safety Chain **DROPS immediately** @ A2116 - Lt 10.
- [] Verify Cave 3 Safety Chain **DROPS immediately** @ A2116 - Lt 43.
- [] Verify Cyclotron Redundant Radiation Safety Chain **DROPS immediately** @ A1711.
(RF Permissive light **OFF** and Cave 3 Safety Chain OK light **OFF**,
Cave 3 Beam Plug In light **OFF**)
- [] Verify that beam plug closes automatically.
- [] Verify Main Safety Chain **COMPLETE** @ A2116 - Lt 1,
when beam plug actuator operates beam plug closed switch.
- [] Verify Cyclotron Redundant Radiation Safety Chain
COMPLETE to RF Permissive light @ A1711,
when beam plug actuator operates beam plug closed switch.
(RF Permissive light **ON** and Cave 3 Beam Plug In light **ON**,
Cave 3 Cave Safety Chain OK light **OFF**)
- [] Return Run/Safe Switch to RUN position.
- [] Verify Main Safety Chain remains **COMPLETE** @ A2116 - Lt 1.
- [] Verify Cave 3 Safety Chain **COMPLETE** @ A2116 - Lt 41.
- [] Verify Cyclotron Redundant Radiation Safety Chain
remains **COMPLETE** to RF Permissive light @ A1711.
(RF Permissive light **ON** and Cave 3 Beam Plug In light **ON**,
Cave 3 Cave Safety Chain OK light **ON**)

Completed by: _____ Date: _____

88-PROCEDURE-001 Version-2.0 Safety Interlock System Chain Check Procedure

Attachment P: CAVE BEAM PLUG Chain Check

Cave 4 Beam Plug Check

- [] Make up Cave 4 Safety Chain.
[Cave 4 Castell Key to A938 Panel in Control Room]
- [] Open beam plug (guillotine) to Cave 4.
- [] Verify Main Safety Chain **COMPLETE** @ A2116 - Lt 1.
- [] Verify Cave 4 Safety Chain **COMPLETE** @ A2119 - Lt 7.
- [] Verify Cyclotron Redundant Radiation Safety Chain
COMPLETE to RF Permissive light @ A1711.
(RF Permissive light **ON** and Cave 4 Safety Chain OK light **ON**,
Cave 4 Beam Plug In light **OFF**)
- [] Move Run/Safe Switch at Cave 4 Door Controls Panel S710
(Cave 4 Door R/S Switch) to the SAFE position.
- [] Verify Main Safety Chain **DROPS immediately** @ A2116 - Lt 9.
- [] Verify Cave 4 Safety Chain **DROPS immediately** @ A2119 - Lt 9.
- [] Verify Cyclotron Redundant Radiation Safety Chain **DROPS immediately** @ A1711.
(RF Permissive light **OFF** and Cave 4 Safety Chain OK light **OFF**,
Cave 4 Beam Plug In light **OFF**)
- [] Verify that beam plug (guillotine) closes automatically.
- [] Verify Main Safety Chain **COMPLETE** @ A2116 - Lt 1,
when beam plug (guillotine) actuator operates beam plug (guillotine) closed switch.
- [] Verify Cyclotron Redundant Radiation Safety Chain
COMPLETE to RF Permissive light @ A1711,
when beam plug (guillotine) actuator operates beam plug (guillotine) closed switch.
(RF Permissive light **ON** and Cave 4 Beam Plug In light **ON**,
Cave 4 Cave Safety Chain OK light **OFF**)
- [] Return Run/Safe Switch to RUN position.
- [] Verify Main Safety Chain remains **COMPLETE** @ A2116 - Lt 1.
- [] Verify Cave 4 Safety Chain **COMPLETE** @ A2119 - Lt 7.
- [] Verify Cyclotron Redundant Radiation Safety Chain
remains **COMPLETE** to RF Permissive light @ A1711.
(RF Permissive light **ON** and Cave 4 Beam Plug In light **ON**,
Cave 4 Cave Safety Chain OK light **ON**)

Completed by: _____ Date: _____

88-PROCEDURE-001 Version-2.0 Safety Interlock System Chain Check Procedure

Attachment P: CAVE BEAM PLUG Chain Check

Cave 4A Beam Plug Check

- [] Make up Cave 4A Safety Chain.
[Cave 4A Castell Key to A938 Panel in Control Room]
- [] Open G3A1 guillotine and Cave 4A beam plug. (Takes about 30 seconds)
- [] Verify Main Safety Chain **COMPLETE** @ A2116 - Lt 1.
- [] Verify Cave 4A Safety Chain **COMPLETE** @ A2119 - Lt 1.
- [] Verify Cyclotron Redundant Radiation Safety Chain
COMPLETE to RF Permissive light @ A1711.
(RF Permissive light **ON** and Cave 4A Safety Chain OK light **ON**,
Cave 4A Beam Plug In light **OFF**)
- [] Move Run/Safe Switch at Cave 4A Door Controls Panel S110
(Cave 4A Door R/S Switch) to the SAFE position.
- [] Verify Main Safety Chain **DROPS immediately** @ A2116 - Lt 8.
- [] Verify Cave 4A Safety Chain **DROPS immediately** @ A2119 - Lt 3.
- [] Verify Cyclotron Redundant Radiation Safety Chain **DROPS immediately** @ A1711. (RF Permissive light **OFF** and Cave 4A Safety Chain OK light **OFF**, Cave 4A Beam Plug In light **OFF**)
- [] Verify that beam plug 4A and guillotine G3A1 close automatically.
- [] Verify Main Safety Chain **COMPLETE** @ A2116 - Lt 1,
when beam plug actuator operates beam plug closed switch.
- [] Verify Cyclotron Redundant Radiation Safety Chain
COMPLETE to RF Permissive light @ A1711,
when beam plug actuator operates beam plug closed switch.
(RF Permissive light **ON** and Cave 4A Beam Plug In light **ON**,
Cave 4A Cave Safety Chain OK light **OFF**)
- [] Return Run/Safe Switch to RUN position.
- [] Verify Main Safety Chain remains **COMPLETE** @ A2116 - Lt 1.
- [] Verify Cave 4A Safety Chain **COMPLETE** @ A2119 - Lt 1.
- [] Verify Cyclotron Redundant Radiation Safety Chain
remains **COMPLETE** to RF Permissive light @ A1711.
(RF Permissive light **ON** and Cave 4A Beam Plug In light **ON**,
Cave 4A Cave Safety Chain OK light **ON**)

Completed by: _____ Date: _____

88-PROCEDURE-001 Version-2.0 Safety Interlock System Chain Check Procedure

Attachment P: CAVE BEAM PLUG Chain Check

Cave 4B Beam Plug Check

- [] Make up Cave 4B Safety Chain.
[Cave 4B Castell Key to A938 Panel in Control Room]
- [] Open beam plug to Cave 4B. (Takes about 30 seconds)
- [] Verify Main Safety Chain **COMPLETE** @ A2116 - Lt 1.
- [] Verify Cave 4B Safety Chain **COMPLETE** @ A2121 - Lt 7.
- [] Verify Cyclotron Redundant Radiation Safety Chain
COMPLETE to RF Permissive light @ A1711.
(RF Permissive light **ON** and Cave 4B Safety Chain OK light **ON**,
Cave 4B Beam Plug In light **OFF**)
- [] Move Run/Safe Switch at Cave 4B Door Controls Panel S410
(Cave 4B Door R/S Switch) to the SAFE position.
- [] Verify Main Safety Chain **DROPS immediately** @ A2116 - Lt 7.
- [] Verify Cave 4B Safety Chain **DROPS immediately** @ A2121 - Lt 9.
- [] Verify Cyclotron Redundant Radiation Safety Chain **DROPS immediately** @ A1711.
(RF Permissive light **OFF** and Cave 4B Safety Chain OK light **OFF**,
Cave 4B Beam Plug In light **OFF**)
- [] Verify that beam plug closes automatically.
- [] Verify Main Safety Chain **COMPLETE** @ A2116 - Lt 1,
when beam plug actuator operates beam plug closed switch.
- [] Verify Cyclotron Redundant Radiation Safety Chain
COMPLETE to RF Permissive light @ A1711,
when beam plug actuator operates beam plug closed switch.
(RF Permissive light **ON** and Cave 4B Beam Plug In light **ON**,
Cave 4B Cave Safety Chain OK light **OFF**)
- [] Return Run/Safe Switch to RUN position.
- [] Verify Main Safety Chain remains **COMPLETE** @ A2116 - Lt 1.
- [] Verify Cave 4B Safety Chain **COMPLETE** @ A2121 - Lt 7.
- [] Verify Cyclotron Redundant Radiation Safety Chain
remains **COMPLETE** to RF Permissive light @ A1711.
(RF Permissive light **ON** and Cave 4B Beam Plug In light **ON**,
Cave 4B Cave Safety Chain OK light **ON**)

Completed by: _____ Date: _____

88-PROCEDURE-001 Version-2.0 Safety Interlock System Chain Check Procedure

Attachment P: CAVE BEAM PLUG Chain Check

Cave 4C Beam Plug Check

- [] Make up Cave 4C Safety Chain.
[Cave 4C Castell Key to A938 Panel in Control Room]
- [] Open beam plug to Cave 4C. (Takes about 30 seconds)
- [] Verify Main Safety Chain **COMPLETE** @ A2116 - Lt 1.
- [] Verify Cave 4C Safety Chain **COMPLETE** @ A2121 - Lt 1.
- [] Verify Cyclotron Redundant Radiation Safety Chain
COMPLETE to RF Permissive light @ A1711.
(RF Permissive light **ON** and Cave 4C Safety Chain OK light **ON**,
Cave 4C Beam Plug In light **OFF**)
- [] Move Run/Safe Switch at Cave 4C Door Controls Panel S510
(Cave 4C Door R/S Switch) to the SAFE position.
- [] Verify Main Safety Chain **DROPS immediately** @ A2116 - Lt 6.
- [] Verify Cave 4C Safety Chain **DROPS immediately** @ A2121 - Lt 3.
- [] Verify Cyclotron Redundant Radiation Safety Chain **DROPS immediately** @ A1711.
(RF Permissive light **OFF** and Cave 4C Safety Chain OK light **OFF**,
Cave 4C Beam Plug In light **OFF**)
- [] Verify that beam plug closes automatically.
- [] Verify Main Safety Chain **COMPLETE** @ A2116 - Lt 1,
when beam plug actuator operates beam plug closed switch.
- [] Verify Cyclotron Redundant Radiation Safety Chain
COMPLETE to RF Permissive light @ A1711,
when beam plug actuator operates beam plug closed switch.
(RF Permissive light **ON** and Cave 4C Beam Plug In light **ON**,
Cave 4C Cave Safety Chain OK light **OFF**)
- [] Return Run/Safe Switch to RUN position.
- [] Verify Main Safety Chain remains **COMPLETE** @ A2116 - Lt 1.
- [] Verify Cave 4C Safety Chain **COMPLETE** @ A2121 - Lt 1.
- [] Verify Cyclotron Redundant Radiation Safety Chain
remains **COMPLETE** to RF Permissive light @ A1711.
(RF Permissive light **ON** and Cave 4C Beam Plug In light **ON**,
Cave 4C Cave Safety Chain OK light **ON**)

Completed by: _____ Date: _____